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13. ABSTRACT (Maximum 200 words)

This study developed and demonstrated an analytical methodology that can optimize multiple objectives, subject to programmatic and budget constraints, in the development and evaluation of pollution abatement and prevention investment strategies supporting US Army activities and facilities. It possesses the capability to modify inputs to determine changes and impacts of the different investment strategies produced. Outputs include investment strategies which address what should be bought, when, and where, the costs of the investment, and the benefits derived in terms of pollution reduced (in volume), cost (O&S) and energy savings. Products can be produced at the Army level, MACOM, state, region, or installation. The methodology is inherently flexible and transferable such that it can readily incorporate changes in policy, data elements, and analytical approach to develop and evaluate investment strategies in other Army environmental programs. The PAPA Investment Model (PIM) is a multiobjective, mixed integer linear program, written in C + +, using EXCEL spreadsheet format input.

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STUDY REPORT
CAA-SR-94-6

POLLUTION ABATEMENT AND PREVENTION ANALYSIS (PAPA) STUDY

October 1994

Prepared by

Resource Analysis Division

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DEPARTMENT OF THE ARMY
US ARMY CONCEPTS ANALYSIS AGENCY
8120 WOODMONT AVENUE
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REPLY TO
ATTENTION OF:

CSCA-RSR (5-5d)

3 NOV 1994

MEMORANDUM FOR Office of the Assistant Secretary of the Army for Installations, Logistics and Environment (ASAILE), Washington, DC 20310-0300

SUBJECT: Pollution Abatement and Prevention Analysis (PAPA) Study Final Report

1. Reference memorandum, DASA-ESOH, 30 December 1993, subject: Pollution Abatement and Prevention Analysis (PAPA) Study Directive.

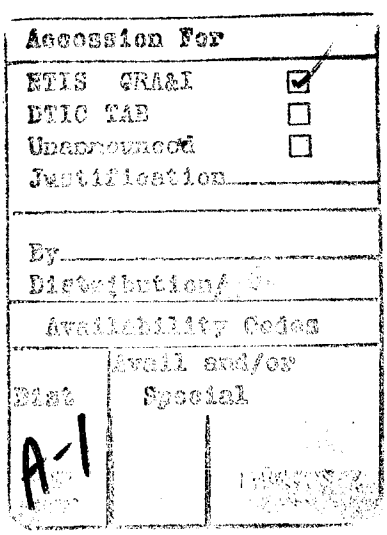
2. Reference document requested the U.S. Army Concepts Analysis Agency (CAA) develop and demonstrate an analytical methodology for evaluating the costs and benefits in investing in pollution abatement and prevention opportunities supporting U.S. Army activities and facilities.

3. The enclosed report documents the results of our analysis, and incorporates your comments to the draft report The study summary at the beginning of the report provides an overview of the effort.

4. CAA expresses appreciation to elements of the Army Materiel Command (AMC) Headquarters and AMC agencies for making available portions of the data used in the analysis. Questions and/or inquiries should be directed to the Resource Analysis Division, U.S. Army Concepts Analysis Agency, 8120 Woodmont Avenue, Bethesda, MD 20814-2797, DSN 295-5289.

E. B. VANDIVER III
Director

Encl



CAA — Concepts Analysis Agency, United States Army	**POLLUTION ABATEMENT AND PREVENTION ANALYSIS (PAPA) STUDY**	**STUDY SUMMARY CAA-SR-94-6**

THE REASON FOR PERFORMING THE STUDY was to develop and demonstrate an analytical methodology for evaluating the costs and benefits of investing in pollution abatement and prevention opportunities (PPOs) supporting US Army activities and facilities.

THE STUDY SPONSOR was the Assistant Secretary of the Army for Installations, Logistics, and Environment (ASAIL&E).

THE STUDY OBJECTIVES were to:

(1) Identify and evaluate pollution abatement opportunities.

(2) Identify and evaluate pollution prevention opportunities.

(3) Develop an analytical capability to generate and evaluate pollution abatement and prevention investment strategies supporting US Army activities and facilities.

(4) Develop and analyze pollution abatement and prevention investment strategies at selected continental United States (CONUS) Army facilities.

THE SCOPE OF THE STUDY

(1) Timeframe for analysis is fiscal year (FY) 1994 through FY 2001.

(2) Army activities and facilities in CONUS only.

(3) Toxic chemicals described in section 313(c) of the Emergency Planning and Community Right-to-Know Act (EPCRA).

(4) Pollution abatement and prevention opportunities and activities that are in research, development, demonstration, and commercialization.

(5) Selected case studies jointly identified with the study sponsor will be used to demonstrate the methodology.

THE BASIC APPROACH used in this study was first to identify pollution abatement and prevention opportunities by hazardous waste stream, and then define the pollution baseline at the US Army Materiel Command (AMC) base case sites. A multiobjective mathematical programming model was developed that generates pollution abatement and prevention investment strategies for Army facilities. The PAPA methodology was demonstrated in support of the Army's response to key

provisions of Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements.

THE PRINCIPAL FINDINGS of the PAPA Study are:

(1) The PAPA methodology provides the Army's leadership with a quick turnaround capability for analyzing and integrating US environmental policy with the Army's environmental goals and its programming and budgeting process in support of the requirements of Executive Order 12856.

(2) The Army's environmental program can be more analytically based, integrated, and defensible by using the PAPA methodology.

(3) The utility of the RCS 1383 Environmental, Pollution Prevention, Control, and Abatement Report can be enhanced by the addition of project-specific life cycle costs, benefits, and waste stream/chemical identification data.

(4) The PAPA methodology is inherently flexible and capable of incorporating changes in policy, budgetary, and technical data elements to develop and evaluate alternative investment strategies within and across the pillars of the Army's environmental program.

(5) The PAPA methodology can be used by senior Army management to assess broad impacts of environmental policy changes and to assist in formulating new policy focused on achieving the Army's environmental objectives.

(6) Major Army command (MACOM) and installation commanders can use the data generated by PAPA methodology to better develop their installation-level investment strategies and corrective action compliance plans.

(7) Unexpected or unanticipated costs (e.g., notices of violation, Federal Facility Compliance Act enforcement, etc.) which occur during the execution year are considered "operating costs" and must be paid for out of the command's annual operating budget.

THE STUDY EFFORT was directed by LTC Michael J. Leibel, Resource Analysis Division, Resources and Sustainability Analysis, US Army Concepts Analysis Agency (CAA).

COMMENTS AND QUESTIONS may be sent to the Director, US Army Concepts Analysis Agency, ATTN: CSCA-RSR, 8120 Woodmont Avenue, Bethesda, Maryland 20814-2797.

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POLLUTION ABATEMENT AND PREVENTION ANALYSIS (PAPA) STUDY

CHAPTER 1

EXECUTIVE SUMMARY

1-1. PURPOSE. The purpose of the Pollution Abatement and Prevention and Analysis (PAPA) Study was to develop and demonstrate an analytical methodology for evaluating the costs and benefits of investing in pollution abatement and prevention opportunities (PPOs) supporting US Army activities and facilities. For the purpose of this study, PPOs refer to both pollution abatement and pollution prevention opportunities. A PPO is a technology, process, or procedure which, when used, installed, or substituted for an existing method, will prevent, eliminate, or reduce the generation of pollution. This definition satisfies the intent of the Pollution Prevention Act of 1990 and Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements. Analyzing and evaluating both pollution abatement and prevention technologies provides the Army with a better opportunity to meet the requirements set forth in the Executive Order.

1-2. BACKGROUND

a. The Army requires a quick turnaround decision support capability for developing and evaluating investment strategies to prevent or reduce pollution, reduce operating compliance costs, and comply with Army environmental policy. Specifically, the PAPA methodology will be applied to produce investment strategies for the Army which comply with the mandates set forth in Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements. The PAPA approach will assist decisionmakers in prioritizing pollution abatement and prevention programs for US Army facilities and activities and, in general, support the environmental policy formulation process for the future.

b. The Pollution Prevention Act of 1990. The Pollution Prevention Act of 1990 established a hierarchy for pollution management as a matter of national policy. It declared that pollution should be prevented or reduced at the source first, or whenever feasible; if prevention or reduction was not achievable, then pollution should be recycled; when not prevented, reduced, or recycled, then pollution should be treated in an environmentally safe manner; and only as a last resort, if the other methods of pollution management were not possible, then and only then should pollution be safely disposed or released into the environment.

c. Executive Order 12856 - Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements. On 3 August 1993, the President signed Executive Order 12856. Executive Order 12856 establishes the Federal government as the leader in pollution prevention and directs compliance with sections 301 through 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). Briefly, Executive Order 12856 directs the Federal government to comply with the same emergency planning, safety, and reporting requirements regarding hazardous/toxic chemical spills and releases that the private sector had been complying with for

years. The Executive Order specifically directs the Federal government to develop a toxic chemical inventory and baseline by 1994; reduce and/or eliminate acquisition and procurement of products containing toxic chemicals; revise all specifications and standards to reduce or eliminate toxic chemicals by 31 December 1999; reduce toxic chemical releases and offsite transfers by 50 percent by 31 December 1999; and finally, develop strategies to implement these reductions. As stated in section 3-302 (b) of the Executive Order, "the baseline levels to which the 50 percent reduction goal applies shall be the aggregate amount of toxic chemicals reported in the baseline year for all of that Federal agency's facilities meeting the threshold applicability requirements set forth in section 1-102 of this [Executive] order." (Appendix G). Source reduction practices of abatement and prevention will be used to the maximum extent practicable to achieve these goals.

d. US Army Environmental Strategy into the 21st Century. Policy for the United States Army's environmental program is set forth in the *US Army Environmental Strategy into the 21st Century*. This document organizes Army policy into four categories: compliance, restoration, prevention, and conservation. These categories are referred to as the four "pillars" of the Army environmental program. This concept is used at all levels of the Department of the Army when dealing with environmental matters.

(1) The compliance pillar ensures that all Army activities and operations at installations and civil works project sites comply with the environmental standards, laws, and regulations set forth by Federal, state, and local governments, by applicable host nations, and by the Department of the Army. Applicable areas include solid and hazardous waste management, wastewater discharge, noise abatement, endangered species, wetlands, air quality attainment, and historic sites. Over the past 10 years, compliance activities have consumed the majority of the Army's programmed environmental dollars. Projects under this pillar are generally categorized as "must fund" projects.

(2) The restoration pillar focuses on cleaning up contaminated sites at Army installations and civil works projects. Sites specifically addressed are those identified under the Installation Restoration Program and the Formerly Used Defense Sites. The Army works in conjunction with the US Environmental Protection Agency (EPA) and the states to determine cleanup measures and dates of completion. Once sites are identified for cleanup, a risk assessment is performed and resources are allocated for cleanup. Department of Defense (DOD) has given the Army responsibility for implementing the Defense Environmental Restoration Program (DERP) for sites formerly owned or used by any DOD component. Due to the nature and visibility of restoration projects, these activities have consumed the largest total environmental dollars within DOD. Funding is provided under separate appropriation which is administered by the Office of the Secretary of Defense (OSD)--the Defense Environmental Restoration Account (DERA).

(3) The prevention pillar focuses on preventing or eliminating pollution. Source reduction is preferred, but other options such as recycling, treatment, and safe disposal are also considered. Minimizing or eliminating the use, generation, release, transfer, and disposal of hazardous materials at Army installations is the main goal of this pillar. The pollution prevention pillar and its emphasis on source reduction/elimination requires changing the way the Army has conducted its business in the past. Long-term pollution prevention, reduction, and eventual elimination

requires commitment at all department levels. The pollution prevention pillar has not received as much funding as the two previously discussed pillars.

(4) The conservation pillar is the fourth pillar of the Army's environmental program. Similar to the pollution prevention pillar, the compliance pillar has historically been funded the least. Conservation and preservation are the two components of this pillar. Conservation focuses on responsibly managing Army lands to ensure natural resource productivity. Preservation focuses on protecting the existing natural, national, cultural, and historical resources at Army sites.

The policies inherent to the four pillars concept provide a framework for implementing Army environmental stewardship responsibilities. Actions taken by the United States Army in pursuit of this stewardship will affect all aspects of the Army's overall mission. It is difficult to conceive an activity which is devoid of environmental implications. A sound environmental ethic should pervade all facets of Army planning, programming, budgeting, and execution.

(5) Although all pillars should be considered when dealing with Army environmental matters this study effort focuses only on the pollution prevention pillar for demonstration and application purposes. The PAPA methodology, is inherently flexible, and can be applied to the other pillars, given that the same data elements are provided as input. Only minor modifications to the model would be necessary. Future areas of study which cross pillars are possible.

1-3. SCOPE. The scope of PAPA is outlined below.

a. Timeframe for analysis is fiscal year (FY) 1994 through FY 2001.

b. Army activities and facilities in the continental United States (CONUS) only.

c. Toxic chemicals described in section 313(c) of the Emergency Planning and Community Right-to-Know Act.

d. Pollution abatement and prevention opportunities and activities that are in research, development, demonstration, and commercialization.

e. Selected case studies jointly identified with study sponsor will be used to demonstrate the methodology.

1-4. OBJECTIVES

a. Identify and evaluate pollution abatement opportunities.

b. Identify and evaluate pollution prevention opportunities.

c. Develop an analytical capability to generate and evaluate pollution abatement and prevention investment strategies supporting US Army activities and facilities.

d. Develop and analyze pollution abatement and prevention investment strategies at selected CONUS Army facilities.

1-5. METHODOLOGY

a. Overview. The methodology used to conduct the PAPA Study is illustrated in Figure 1-1. The primary objective of this study was to develop and demonstrate a methodology that can be used to develop, evaluate, and demonstrate optimal PPO investment strategies in the Army. An integrated, economic operations research and environmental approach was developed for addressing the major issues associated with the formulation and analysis of these strategies. Four tasks compose the methodology. Task 1 identified pollution abatement and prevention opportunities at a selected group of Army facilities. Building and testing the PAPA Investment Model was accomplished in Task 2. Task 3 involved the identification and analysis of a pollution baseline for the selected Army facilities. In Task 4, the PAPA Investment Model was used to develop and evaluate PPO investment strategies for the base case using the data provided from the selected sites.

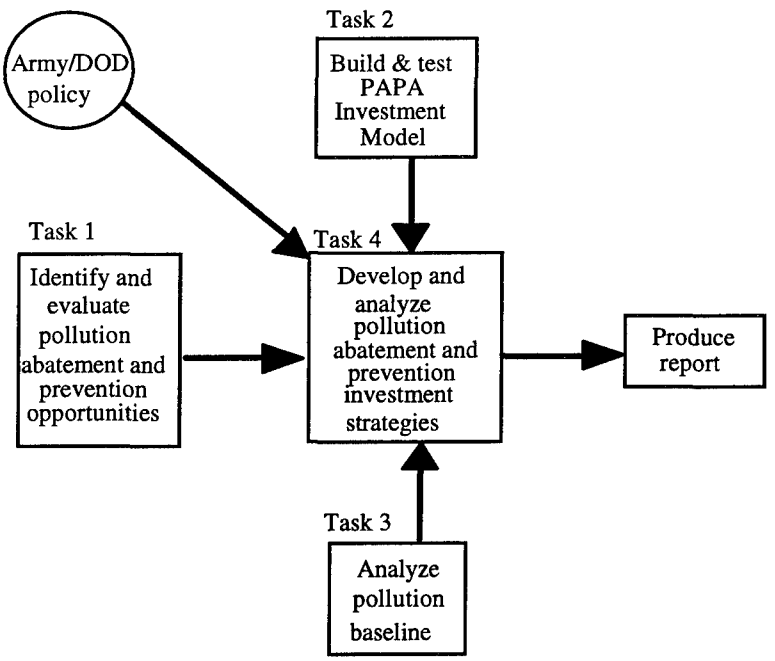


Figure 1-1. PAPA Study Methodology

b. Task 1 - Identify and Evaluate Pollution Abatement and Prevention Opportunities. Task 1 focused on identifying PPOs. For the purpose of this study, PPOs refer to both pollution abatement and pollution prevention opportunities. A PPO is a technology, process, or procedure which, when used, installed, or substituted for an existing method, will prevent, eliminate or reduce the generation of pollution. Data were initially gathered from three US Army Materiel Command (AMC) installations identified as base case sites--Corpus Christi Army Depot, Lone Star Army Ammunition Plant, and Watervliet Arsenal. PPO data were also gathered from the

Industrial Operations Command (Center for Technical Excellence) (IOC(CTX)) located at Letterkenny Army Depot. The IOC (CTX) researches PPOs by industrial process. They provided additional PPO data from Anniston Army Depot; Red River Army Depot; Tobyhanna Army Depot; and Tooele Army Depot. Chapter 3 further describes the data collected from all sites. Data elements characteristic of each PPO and critical to the input of the PAPA Investment Model are: annual waste streams (kilograms (kg) or short tons (STON)/year); annual cost savings (+/-) (dollars/year); annual energy savings (+/-) (kilowatt hour (kWh/year); annual pollutant reduction (kg or STON/year); expected economic life (in years); total investment cost ($); and annual operating and maintenance costs ($/year).

c. Task 2 - Build and Test the PAPA Investment Model (PIM). Task 2 focused on building and testing the PAPA Investment Model (PIM). The PIM is a multiobjective, linear programming model, used to generate and analyze optimal PPO investment strategies at US Army facilities. These optimizations are performed over the FY period of interest, yielding, for each FY in the period, what PPOs to buy and at which Army facilities. Depending on the criteria invoked, the model can maximize pollutant reduction, cost savings, energy savings, and/or minimize investment costs resulting from PPO investment strategies. Initial testing of the PIM used data on energy conservation opportunities (ECO) analyzed in the Renewables and Energy Efficiency Planning (REEP) Study conducted by the US Army Concepts Analysis Agency (CAA).

d. Task 3 - Analyze the Pollution Baseline. Based on discussions with the study sponsor, it was decided that AMC would be the most appropriate choice for analysis due to their industrial base mission. Over the past few years, AMC has accounted for over 80 percent of the Army's total reported hazardous waste disposal. For example, over 70 percent of the total waste generated at AMC depot installations result from three processes: cleaning, paint removal, and surface treatment. These processes normally use toxic chemicals or compounds which include 1-1-1 trichloroethane, xylene, methyl ethyl ketone, toulene, chromium, lead, and cadmium, all of which are listed in section 313(c) of EPCRA. AMC has been collecting data on these process waste streams under its Hazardous Waste Minimization/Pollution Prevention (HAZMIN/PP) Program since 1985. The PPOs identified tend to be process-oriented, with a focus on source reduction. The baseline for this study was established using AMC's 1992 Installation Hazardous Waste Generation Report.

e. Task 4 - Develop and Analyze Pollution Abatement and Prevention Investment Strategies at Selected AMC Installations. The purpose of this task was to apply the PAPA methodology to develop and evaluate PPO investment strategies for selected Army facilities. By formulating a strategy, the capability of the PAPA Investment Model for use in making PPO investment decisions would be demonstrated. A base case scenario was developed that incorporated Army environmental policy and the Federal mandates set forth in Executive Order 12856. Each strategy describes what technologies to buy, when to buy them (fiscal year), and at which sites; the annual and total pollutant reduction, cost savings, energy savings; and investment strategy costs.

1-6. FINDINGS AND RECOMMENDATIONS. The PAPA methodology utilizes an economic, operations research, and environmental approach for evaluating and implementing national, DOD, and Army environmental policy. This is accomplished through an optimization process which produces pollution abatement and prevention opportunity investment strategies that yield the most benefit possible (e.g., reduce pollution releases and thus improve the environment) given a set of resource constraints, policy goals, requirements, and technologies.

a. This paragraph highlights the major findings of the PAPA Study:

(1) The PAPA methodology provides the Army's leadership with a quick turnaround capability for analyzing and integrating US environmental policy with the Army's environmental goals and its programming and budgeting process in support of the requirements of Executive Order 12856.

(2) The Army's environmental program can be more analytically based, integrated, and defensible by using the PAPA methodology. Decisionmakers would be better able to quickly develop and assess "cause and effect" impacts of policy changes, providing a more sound basis for developing and evaluating investment strategies that logically support the Army's long-range environmental policy objectives.

(3) The utility of the RCS 1383 Environmental, Pollution Prevention, Control, and Abatement Report can be enhanced by the addition of project specific life cycle costs, benefits, and waste stream/chemical identification data. These project data (cost and energy savings and, most importantly, pollution reduction) are critical in developing sound investment strategies.

(4) The PAPA methodology is inherently flexible and capable of incorporating changes in policy, budgetary, and technical data elements to develop and evaluate alternative investment strategies within and across the pillars of the Army's environmental program. Investment strategies are not limited to facility type projects only, but can be developed where investment costs and benefits can be measured and input into the PIM.

(5) The PAPA methodology can be used by senior Army management to assess broad impacts of environmental policy changes and to assist in formulating new policy focused on achieving the Army's environmental objectives. Collectively quantifying and analyzing the costs and benefits of the Army's environmental program projects will help support long-range planning and policy compliance requirements.

(6) MACOM and installation commanders can use the data generated by the PAPA methodology to better develop their installation level investment strategies and corrective action compliance plans. The installation level analysis can focus on "how best to achieve stated objectives" given site unique conditions and budget constraints.

(7) Unexpected or unanticipated costs (e.g., notices of violation, Federal Facility Compliance Act enforcement, etc.) which occur during the execution year are included, by policy, as

"operating costs" and paid for out of the command's annual operating budget. This policy reduces the amount of programmed dollars above the "must fund" line which can be used for investing in pollution abatement and prevention projects.

b. This paragraph highlights the major recommendations of the PAPA Study:

(1) The PAPA methodology should be used to generate investment strategy products for use by decisionmakers at all levels to prevent or reduce pollution, reduce operating costs, and support the requirements of Executive Order 12856.

(2) The PAPA methodology should be used as a planning and programming tool by senior Army management to develop a more fully integrated and defensible environmental program. Pollution abatement and prevention investment projects, articulated with cost/benefit data, can then be incorporated in the Army's Environmental Strategy Action Plan as investments rather than compliance issues.

(a) Project data identifying waste streams/chemicals and project life cycle costs and benefits should be developed and collected within each program pillar. Provision should be included to audit the data collected against subsequent field experience.

(b) Using the data collected, the methodology should then be applied to develop and evaluate investment strategies and their impacts.

(c) The investment strategies developed should then be collectively analyzed to produce a more fully integrated environmental program that supports the Army's policy objectives.

(d) The PAPA methodology should be used as a management tool to assess broad impacts and implications of environmental policy changes. It could also be used in support of environmental policy development and evaluation in the Army.

(3) Cost/benefit data generated by the PAPA methodology should be used by commanders to better define and develop their pollution abatement and prevention projects and support installation-level environmental program compliance plans for corrective action.

CHAPTER 2

METHODOLOGY

2-1. INTRODUCTION

a. This chapter presents the PAPA study methodology as illustrated in Figure 2-1. The primary purpose of this study was to develop and demonstrate a capability which formulates and evaluates costs and benefits of investing in pollution abatement and prevention opportunities at US Army activities and facilities. The methodology was demonstrated by developing illustrative investment strategies for PPO in the Army that comply with the mandates set forth in Executive Order 12856, Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements. The methodology is generic and can be applied to develop investment strategies across all four pillars of the Army Environmental Strategy Program. It can also integrate national environmental security objectives, OSD guidance, Army environmental and energy goals, and the RCS 1383 data base into the Army Program Objective Memorandum (POM). Finally, it can integrate the development and evaluation of public and private sector environmental technology capabilities into the Army environmental program. Investment strategies can be developed for various perspectives--such as Army, MACOM, installation, state, or region.

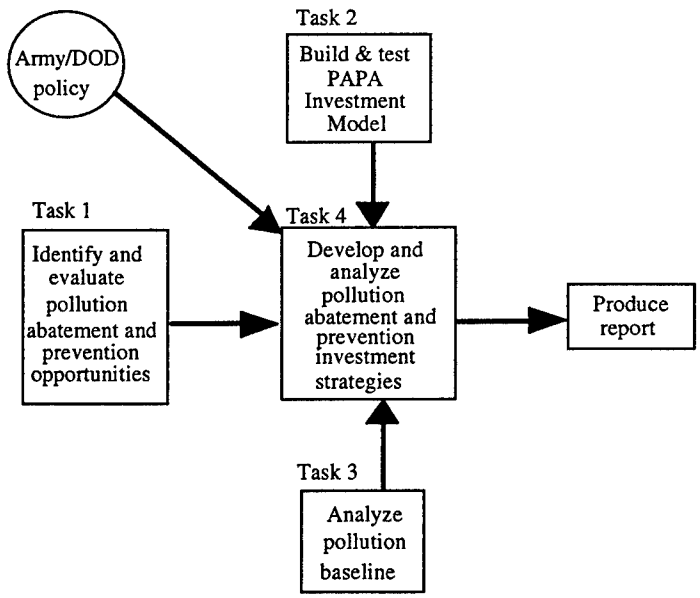


Figure 2-1. PAPA Study Methodology

b. The PAPA methodology is comprised of four tasks. The ordering of the tasks indicates the general sequence of task execution. Although tasks were distinct efforts and generally performed in the order indicated, some tasks were executed concurrently. For example, Task 1 involved identifying and evaluating PPOs. Gathering and refining PPO data was a continuous effort throughout the study and was performed concurrently with Tasks 2, 3, and 4. Task 2 involved

designing, developing, and testing a model that determined the optimum methods (and economic impacts) for investing in these opportunities over time. Task 2 was conducted independent of the other tasks. Task 3 required that a pollution baseline be established and analyzed. However, like Task 1, this task was continuously refined as new data became available and therefore was performed concurrently with Task 1. And lastly, Task 4 developed and evaluated the pollution abatement and prevention opportunity investment strategies. This chapter discusses the individual tasks accomplished in developing the methodology used to perform this study. Each task is described below.

2-2. TASK 1 - IDENTIFY AND EVALUATE POLLUTION ABATEMENT AND PREVENTION OPPORTUNITIES

a. The purpose of this task was to identify and assess ways to reduce or eliminate hazardous waste streams produced at CONUS Army sites. Pollution abatement and prevention opportunities refer to technologies, processes, or procedures which, when used, installed, or substituted for current methods, reduce the generation of pollution. In order to meet the time constraints set forth in Executive Order 12856, the PAPA study team focused on identifying those opportunities which were commercially available, under research and development or currently being demonstrated for use. At the onset of the study, PPOs were to be selected based on the criteria set forth in the Pollution Prevention Act of 1990, and the toxic chemicals described in section 313(c) of the Emergency Planning and Community Right-to-Know Act. However, because of limited data availability (discussed later in this paragraph), a subset of existing PPOs was used to demonstrate the capability of the PAPA methodology. The following paragraphs of Task 1 will discuss PPO criteria, critical data elements required to populate the PAPA Investment Model, sources, and methods of data acquisition.

b. The Pollution Prevention Act of 1990 established a hierarchy for pollution management. It stated that pollution should be prevented or reduced at the source first; if unable to be prevented or reduced, pollution should be recycled in an environmentally safe manner; when not prevented, reduced, or recycled, then it should be treated in an environmentally safe manner; and only as a last resort, if other methods are not feasible, pollution should be *safely* disposed of or released into the environment.

(1) Source reduction manages pollution at its start point. When looking into the industrial-based environment, as the PAPA Study does, source reduction refers to input changes (e.g., change of a raw material used in a process or operation); improvements in processes or operations (e.g., improvement in housekeeping); process modification (e.g., change in a technique that is used to produce a product); or product reformulation (e.g., product substitution or change in the design, composition, or specification of the end product).

(2) The second source of pollution prevention is hazardous waste minimization by/through recycling. Recycling is a process of collecting, transforming, or remanufacturing a material or product for reuse. Recycling can be performed on or offsite.

(3) Treating hazardous waste is the third method of pollution reduction. Typically, processes

used in treating hazardous waste will either reduce the total volume of the waste by increasing the concentration or toxicity level of the hazardous material, or increase the volume of the waste by reducing the concentration or toxicity level. In very few cases will treatment totally eliminate the toxic or hazardous nature of a substance. Treatment is a preliminary step to the final method of pollution reduction--disposal.

(4) Disposal of waste in an environmentally safe manner does not reduce or eliminate the hazardous characteristics of a material. Proper disposal and management of a hazardous or toxic substance restricts or eliminates the risks to human health and adverse impacts of the substance on its surrounding environment.

c. The initial effort to identify PPOs for the study was based on this hierarchy structure and the requirement to identify PPOs by toxic chemical as stated in section 313(c) of EPCRA (and as stated in the PAPA study objectives). The RCS 1383 data base which supports the RCS 1383 Environmental, Pollution Prevention, Control, and Abatement Report was identified as the best source of the required PPOs.

d. Data contained in the RCS 1383 data base is used to support the development of programming and budgeting documents, confirm budget requests, and evaluate the Army's environmental program. It is also used to develop and support budget estimates and the POM. The system is the primary source of information on Army "must fund" environmental projects. An overview of the many functions of the RCS 1383 data base is presented in Table 2-1. The "X" in each column indicates which level of command or management uses the RCS 1383 data and for what purpose.

e. Because the RCS 1383 data base is the primary repository for Army environmental planning information, the study team selected it as the most valid source for identifying pollution abatement and prevention projects. In addition, all Army installations must submit proposed environmental projects for inclusion in the data base, making it the most comprehensive accounting of proposed and ongoing environmental projects. The RCS 1383 data base is also designed to retain information on projects already completed, thus making it a historical record of all previous Army pollution abatement and prevention efforts.

f. In analyzing the RCS 1383 data base, the study team found that less than 11 percent of the total projects beginning in 1994 were identified as "pollution prevention" projects. The study team also determined that the five types of data needed to feed the PAPA Investment Model were not in the RCS 1383 data base. Some of the required data existed in the narrative portion of the data base, but it was neither uniform nor readily available for input into the model. The team therefore concluded that the RCS 1383 data base was not configured to feed data requirements into the PAPA Investment Model. The lack of these data is addressed in Chapter 4 of this report. (Note: in a related finding, analysis of the current 1996 -2001 environmental portion of the Army POM revealed only between 4 and 5 percent of the total dollars were programmed above the "must fund" line for environmental investment type projects.

Table 2-1. Functions of the RCS 1383 Data Base

Install	MACOM	DA	Function
X	X	X	**Identify all Army environmental program requirements.**
		X	**Basis for DA input to OMB A-106 requirement.**
			Support the Army budget process.
X	X	X	Develop budget estimates and POM-year programming documents. Prepare schedules identifying funding levels in program and budget documents.
X	X	X	Track requirements as they are planned, programmed, and budgeted.
X	X	X	Serve as the only budget submission for DERA and BRAC.
		X	Link environmental program management with other Army programs.
		X	Review and validate MACOM POM and budget submission.
		X	Make recommendations to the Program Evaluation Group and senior Army decisionmakers on resource allocations between competing Army programs and requirements.
		X	Develop environmental schedules in the POM and budget submittals to OSD and Congress.
		X	Forecast costs of new program requirements for those policies under development or proposed for promulgation by the Congress or EPA.
	X		Validate installation budget submission to ensure adequate funds are being requested.
			Manage the Environmental Program
X	X	X	Cross-check with ACTS to verify that NOVs requiring projects are properly addressed.
X	X	X	Provide continuity to the environmental program upon personnel turnover.
X	X	X	Manage media-specific programs.
X	X	X	Determine program progress and identify weak program areas.
X	X	X	Reallocate and redistribute funds that become available at mid-year/year-end reviews.
	X	X	Prioritize and distribute funds in times of shortfall.
	X	X	Develop statistical parameters for various uses.
		X	Assess MACOM implementation of Army funding policy for environmental compliance.
		X	Cross-check projects over $1 million against MCA program requirements.
	X	X	Determine training requirements in conjunction with ACTS data.
X	X	X	Document environmental funding requirements for resource allocation decisions.
X	X		Prioritize use of environmental funds to maximize compliance.
	X	X	Determine whether an organization is adequately anticipating and implementing key requirements of its media-specific programs.
X	X		Identify to resource managers executable projects for which funds should be provided
X	X		Track project execution and obligations incurred during execution.

Install = Installation
MACOM = major Army command
DA = Department of the Army
X = Functional use of data by organizational level
Source: Policy and Guidance for Identifying US Army Environmental Program Requirements, US Army Office of The Director of Environmental Programs, Volume 11, July 1993, page 48.

g. The US Army Materiel Command (AMC) is the Army's leader in identifying and managing hazardous waste streams by industrial process. Also reported as the largest generator of pollution in the Army, AMC has been active in the search for more environmentally sound ways of conducting business. Since 1985, AMC has been engaged in managing pollution generation through the AMC HAZMIN/PP Program. The PAPA study team decided to identify PPOs by process and hazardous waste streams as did AMC in this program, as it appeared to be the only way around the toxic chemical identification problem and linkage to a PPO. Once processes and hazardous waste streams were identified, then PPOs could be linked to them.

2-3. TASK 2 - BUILD AND TEST THE PAPA INVESTMENT MODEL (PIM)

a. This task constituted the core of the PAPA methodology--the development of the PAPA Investment Model (PIM). The PIM is a multiobjective, linear programming model used to generate and analyze optimal pollution abatement and prevention opportunity investment strategies at US Army facilities. These optimizations are performed over the FY period of interest, yielding, for each FY in the period, what pollution abatement and prevention opportunities to buy and at which Army facility. Depending on the criteria invoked, the model can maximize pollutant reduction, cost savings, energy savings, and/or minimize investment costs resulting from PPO investment strategies.

b. Data gathered in Task 1 is used as input to the PAPA Investment Model. Model inputs included Army/DOD environmental policy, budget constraints, costs (hardware, software, labor, installation, operations and maintenance, tipping fees, disposal, material), investment costs, benefits, and economies of scale. Model outputs included investment strategies, pollutant reduction, costs, cost savings, and energy savings. Table 2-2 illustrates data inputs and outputs. The types of output required from the PIM were identified during the initial phase of the study and served as a point of departure for establishing the data input required by the model. Chapter 3 addresses the actual data used to demonstrate the model and resulting outputs. Preliminary model testing was done using data gathered from the Renewables and Energy Efficiency Planning (REEP) Study.

Table 2-2. PAPA Data Inputs and Outputs

Inputs	Outputs
Army/DOD Environmental Policy	Investment Strategy Decisions (Quantity, Type, Time, Place)
Budget	Investment Strategy Costs
Investment Criteria	Annual/Total Pollutant Reduction (kg)
Costs	Annual/Total Cost Savings ($)
Economies of Scale	Annual/Total Energy Savings (kWh)

c. The PIM incorporates budget constraints. Budget constraints are established by the amount of funds available for PPO investment in a given fiscal year. In general, budget constraints are set by Army programming policy and Congressional appropriation. PPO investment cannot exceed available funds (as established by the budget constraint) in any fiscal year. The budget constraint

variable is determined outside the PIM. Quantifiable pollution abatement and prevention goals are also regarded as constraints in the model, if they are requirements that must be achieved. An example of a quantifiable pollution abatement and prevention goal would be the requirement established in Executive Order 12856 that releases and offsite transfers of toxic chemicals to the environment from Federal facilities be decreased 50 percent by the end of FY 1999.

d. Pollutant reduction refers to the decrease in waste stream achieved by the implementation of a PPO. This reduction usually occurs from substitution of a hazardous substance with a nonhazardous or less hazardous substance. Pollutant reductions are measured in terms of kilograms.

e. Cost savings refers to the dollars saved by PPO implementation. Dollar savings occur for three principal reasons. First, when a hazardous waste stream is either eliminated or reduced, there is a decrease in disposal costs. Reduction in disposal costs through PPO investment is the largest component of cost savings and is certain to become more prominent as disposal costs rise in the future. Secondly, a PPO involving process change can lead to lower operating costs (e.g., energy costs). This occurs because of changes in the labor and/or material required for a given process. The third reason for PPO cost savings is related to reductions that occur due to changes in administrative costs. If a PPO can eliminate a waste stream completely, then funds spent to manage that waste stream (for functions such as documentation, accountability, etc.) can be saved.

f. Energy savings are the amount of decreased energy consumption obtained through PPO implementation. Energy consumption is reduced through process change. Savings can be substantial if a PPO either greatly reduces operating time (thus energy consumption) or replaces an energy intensive process with a less intensive one. It should be noted that energy savings can take a negative value. That is, a PPO can conceivably replace a nonintensive energy process with a more intensive one. This type of energy dissaving PPO might be implemented because of its strength in another benefit area, such as pollution reduction.

g. Investment costs are the dollars required to purchase and install PPOs. Each site-specific PPO has its own investment cost, which was obtained from Army facility environmental managers. When the PIM invokes the investment cost minimization objective, it produces an investment strategy that obtains a given goal at the minimum cost. For example, suppose an Army environmental goal is to achieve the 50 percent waste stream reduction as called for in Executive Order 12856. Output from PIM would specify the PPO acquisition strategy to attain the 50 percent pollutant reduction goal, and do so at the lowest possible dollar cost.

2-4. TASK 3 - ANALYZE THE POLLUTION BASELINE AT SELECTED AMC INSTALLATIONS (BASE CASE)

a. In order to achieve the study objectives, it was necessary to identify and quantify baseline figures of the toxic chemicals listed in section 313(c) of EPCRA which are used in the industrial processes and ultimately result in a hazardous waste. Of the approximately 400 chemicals listed, typically Army installations report about 35 different chemicals into the Toxic Release Inventory

eachyear. During the study team's site visits and interviews with installation environmental specialists, it was revealed that inventory procedures were most often not in place to accomplish a total "mass balancing" of hazardous materials received, processed, and released (including disposal and offsite transfer) to the environment. Volumes of toxic chemicals could be tracked as they arrived on the installation from the supply system, but only their presence was reported in the materials being disposed of or shipped offsite. Neither the amounts nor the concentrations of chemicals were clearly recorded.

b. The study team also determined from their site visits that most toxic chemicals were not used in their pure state, but were mixed or blended in a variety of processes on the installation. Only in rare instances were chemicals used in a single process. This was further compounded when an output from one process/product became an input to another process/product. Information and monitoring systems were not in place (nor required) to collect data on the toxic chemicals or their characteristics. Their existence was known merely by the fact that they were defined as a component of the process/product. Waste materials were eventually tested for the presence of the chemical and managed due to restrictions/controls imposed for their disposal.

c. The toxic release inventory and reporting requirements of Executive Order 12856 address material visibility and accountability. Once threshold values of toxic chemicals are met, installations must begin to closely track their use and release or offsite transfer. The Toxic Release Inventory (TRI) Report requires that installations account for their releases by media by direct measurement or engineering estimates. In addition to volumes, the method of release and ultimate destination must also be identified. The TRI Report also requires identification of on-site waste treatment methods and efficiencies, recycling activities, and source reduction efforts over a 4-year period.

d. Data collection on PPOs shifted from specific chemicals to the processes and waste streams which contained them. This change was also in line with the intent of the Executive Order and the Pollution Prevention Act of 1990, which focuses on source reduction as the pollution prevention option of choice. Identification of where and why toxic chemicals are used in a process and substituting or eliminating the chemical in the process is one solution for reducing or eliminating the resulting hazardous waste.

e. It also appeared that identifying and evaluating the process or resulting hazardous waste stream would provide a better base to extrapolate successful solutions to other Army installations. This would then allow the PIM to optimize the opportunities from a broader perspective and develop a more comprehensive investment strategy for the Army. Additionally, where a toxic chemical being used in a specific process could not be eliminated in the near term due to technology or design constraints, pollution abatement opportunities could be applied within the process which might result in reductions of use levels or in hazardous wastes generated. These opportunities often were as simple as improved operator training, inventory management, and implementation of material handling controls. A significant point here is that these types of opportunities are of low to no cost, yet generate significant hazardous waste reductions.

f. Since passage of the Pollution Prevention Act of 1990, the Army has made significant progress in reducing the generation of solid and hazardous waste. This is primarily due to AMC's HAZMIN/PP Program, established in 1985, with a 10-year goal of reducing waste generated by 50 percent. By 1992, AMC reported that they and their operating contractors had achieved a 71 percent reduction in the generation of industrial hazardous waste, well in excess of the earlier stated goal. However, Executive Order 12856 established a new baseline and new goals to be achieved.

g. The baseline supporting the Executive Order is calendar year 1994 using the chemical specific information drawn from the TRI Report. Since this chemical-specific baseline was not available, the study team used the existing waste stream data from AMC's 1992 HAZMIN/PP Installation Hazardous Waste Generation Report as the study's baseline. Headquarters, AMC, provided the study team with these data files. Both the study sponsor and Headquarters AMC believed that these files accurately reflected the waste streams present at the base case installations.

2-5. TASK 4 - DEVELOP AND ANALYZE POLLUTION ABATEMENT AND PREVENTION INVESTMENT STRATEGIES AT SELECTED AMC INSTALLATIONS

a. The purpose of this task was to demonstrate the capability of the PAPA methodology to develop and evaluate pollution prevention opportunity investment strategies at selected Army facilities and installations. To accomplish this task, the following base case scenario was established:

> Per Executive Order 12856, what should the investment strategy be to achieve a 50 percent reduction in the release and offsite transfer of toxic chemicals at selected AMC installations at least cost, and can be implemented completely by 31 December 1999?

b. A sample of AMC installations was to be jointly selected by the study team, the study sponsor, and HQ AMC. These installations were to be representative of the total industrial base installation population, reflecting similar missions and size. Common support functions (e.g., motor pool operations) would represent installations outside the Army's industrial base. Availability of good waste stream baseline data was a critical consideration (Task 3).

c. Specific PPO project data was to be collected from each of the sample installations and tied to their identified waste streams (Task 1). Commonality of mission-specific functions, their industrial processes and resulting waste streams, and identified PPOs were to provide a basis for projecting wider application of the PPO to other AMC installations (e.g., paint/depaint, metal parts, cleaning and plating, etc.). The PPO project data is to be collected from existing data sources, during site visits, and by a data call through HQ AMC (Appendix F).

d. The PPO data will then be used by the PIM to produce an investment strategy. As designed, the PIM will produce investment strategies that maximize cost savings, energy savings, pollutant reduction, or minimize investment or life cycle cost. The model can explicitly account for budget constraints, pollution prevention goals, and economies of scale, while formulating optimal investment strategies. Investment strategies will select what PPO to buy, when to buy them, and at which Army facility.

e. Four objective functions can be invoked by the PIM, producing four unique types of output. The minimize investment or life cycle cost objective function produces an investment strategy that acquires a PPO in a manner that attains any specific goal while doing so at the least possible cost. That is, for example, reduce pollutant emissions by a given amount at the lowest cost. Maximization of energy savings produces an investment strategy that purchases PPO such that energy consumption is reduced to the greatest extent possible. This energy reduction can be pursued without regard to investment cost, cost savings, or pollutant reduction. In a similar fashion, the pollutant reduction objective function acquires PPO that yield the largest waste stream reduction attainable, which may or may not consider investment cost, cost savings, or energy consumption reduction. The fourth objective function, maximization of cost savings, results in an investment strategy that achieves the largest amount of dollar savings possible. This cost savings can be pursued without regard to the other objectives.

f. The minimization of investment costs receives special emphasis in Army analyses. This is due to the nature of the Army programming and budgeting process. Since funds never satisfy all demands, planners are constantly shifting resources between Army needs. Programmers and budgeters are interested in information which leads to supporting decisions that require the minimum expenditure to achieve a desired amount of output. In terms of the PAPA model, this would be provided by invoking the "minimum cost" objective function, or satisfying the goal for an objective (cost savings, pollution reduction, or energy savings) at the lowest dollar cost.

CHAPTER 3

ANALYSIS AND RESULTS

3-1. INTRODUCTION. Chapter 3 presents the results of executing the PAPA methodology. The utility of the methodology is highlighted by its flexibility, in that it can readily incorporate changes and improvements in the data. However, in order to maintain the integrity of the methodology, all data and data sources must be kept current. The results of applying the methodology are presented sequentially by task.

3-2. IDENTIFY AND EVALUATE POLLUTION ABATEMENT AND PREVENTION OPPORTUNITIES (TASK 1)

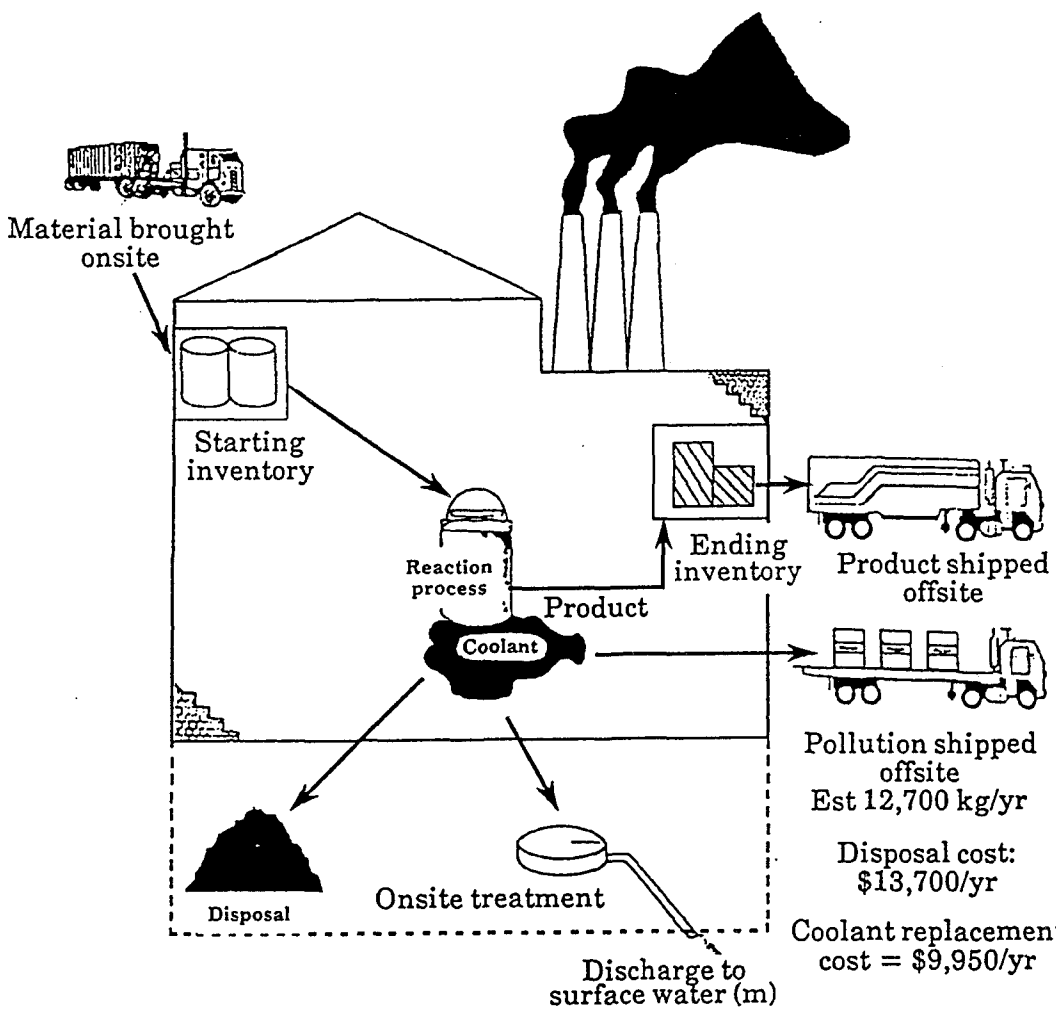
a. During a 10 November 1993 meeting with the sponsor, three AMC installations were identified as data collection and PAPA demonstration sites. The criteria used to select these sites included availability of waste stream and PPO data, confidence levels of the data with HQ AMC and with the sponsor, the variety of their individual missions, the potential for pollution and hazardous waste stream reduction, and the resources available to support this study. The Environmental Quality Office of HQ AMC provided policy and program guidance while the sites provided the specific pollution abatement and prevention opportunity data.

b. The mission diversity of the AMC sites selected for the demonstration was critical in that they needed to represent the majority of the Army's industrial base complex. The sites selected were as follows: Watervliet Arsenal (WVA), NY, a heavy manufacturing facility; Corpus Christi Army Depot (CCAD), TX, an overhaul/rebuild facility; and Lone Star Army Ammunition Plant (LSAAP), TX, a load-assembly-pack ammunition facility. The processes or operations studied would be representative among their respective counterparts (i.e., process-unique, surface treatment, etc.), while operations across the sites would be among the general Army facilities (i.e., motor pool operations, etc.). PPO data were also gathered from the Industrial Operations Command (Center for Technical Excellence). Figure 3-1 lists the PPO data collection sites. Figure 3-2 shows an illustrative example of a PPO. Table 3-1 lists the PPOs by site location.

- Corpus Christi Army Depot, TX
- Lone Star Army Ammo Plant, TX
- Letterkenny Army Depot, PA
- Anniston Army Depot, AL
- Red River Army Depot, AL
- Tobyhanna Army Depot, PA
- Tooele Army Depot, UT
- Watervliet Arsenal, NY

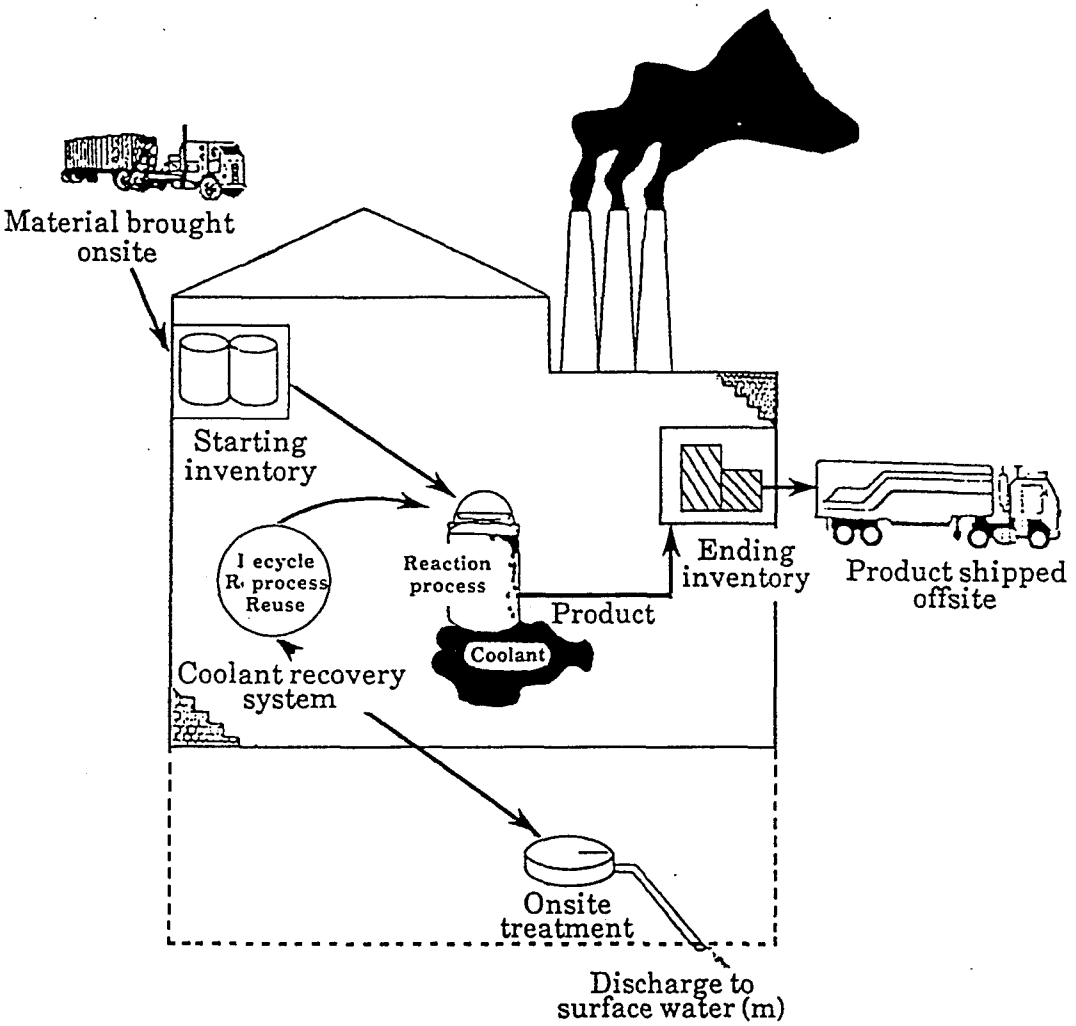
Figure 3-1. PPO Data Collection Sites

c. Figure 3-2 is an illustrative example of a process modification entitled "Coolant Recovery System." The existing process uses petroleum based fluids to cool metal machining operations to maintain surface quality and production rate. Over time, the coolant becomes contaminated with machine oils, solid particles (metal chips), and, due to buildup of moisture and heat, creates a healthy environment for bacteria to grow. This degrades the coolant to the point of becoming ineffective, requiring replacement and disposal. Volumes typically range from 500 to 1,500 gallons per system. The proposed coolant recovery system inserts a filtration unit to remove the tramp oils and solids, and a process to stop bacteria growth. The coolant is restored to original composition and then reused. In this process, the disposal of contaminated coolant is eliminated completely. Significant cost savings can be realized by reducing the amount of coolant purchased to replenish the system as well as the elimination of the contaminated coolant disposal cost. Actual cost savings vary by application.



Existing Process

Figure 3-2. Illustrative Example of a PPO (page 1 of 2 pages)



Investment cost $108,000; estimated cost savings $22,000/year

Disposal cost $686/year (tramp oils and metal chips) (coolant disposal costs - $0)

Pollution shipped offsite = coolant is recycled

Coolant replacement cost = $498/year

Coolant Recovery System

Figure 3-2. Illustrative Example of a PPO (page 2 of 2 pages)

Table 3-1. PPOs by Site

PPOs	Site
Vehicle hull blasting unit	Anniston Army Depot (ANAD)
Airframe paint stripping	Corpus Christi Army Depot
Laser rotor paint stripping	Corpus Christi Army Depot
Paint solvent recovery system	Corpus Christi Army Depot
Alum conv coating filtration system	Corpus Christi Army Depot
Replace chlorinated solvent degreasers	Corpus Christi Army Depot
Coolant recovery system upgrade	Corpus Christi Army Depot
Electrodialytic system	Corpus Christi Army Depot
Upgrade industrial waste treatment plant	Corpus Christi Army Depot
Deionize spray rinse systems	Corpus Christi Army Depot
Waterjet metal spray removal system	Corpus Christi Army Depot
Aqueous ultrasonic cleaning system	Corpus Christi Army Depot
Robotic waterjet paint/rust removal system	Corpus Christi Army Depot
Intermediate size plastic blasting media	Corpus Christi Army Depot
High pressure aqueous wash system	Letterkenny Army Depot (LEAD)
Line trough system integration (K-5)	Lone Star Army Ammunition Plant
Industrial sewer replacement	Lone Star Army Ammunition Plant
Sump and trough canopy system (Area B)	Lone Star Army Ammunition Plant
Sump and trough system installation (G-7)	Lone Star Army Ammunition Plant
Mechanical cleaning system	Lone Star Army Ammunition Plant
Treated waste water equipment installation	Lone Star Army Ammunition Plant
High pressure aqueous wash systems	Red River Army Depot (RRAD)
Electrodialysis plating system	Tobyhanna Army Depot (TOAD)
Organic washwater cleaning system	Tooele Army Depot (TEAD)
Electrodialysis plating solution recycling	Watervliet Arsenal
IONSEP electropolish solution recycling	Watervliet Arsenal

d. Data elements characteristic of each PPO and critical to the input of the PAPA Investment Model were: annual waste streams (kg/year); annual cost savings (+/-) (dollars/year); annual energy savings (+/-) (kWh/year); annual pollutant reduction (kg/year); expected economic life (years); total investment cost ($); and annual operating and maintenance costs ($/year).

e. These specific data elements were collected by PPO as a result of a data call from HQ AMC, supporting the PAPA study effort (Appendix F). The primary source of PPO data came from the HQ AMC and the IOC (CTX). Study team members made site visits to gather the data. In some cases, the data survey sheets were mailed or faxed to the study team. Other organizations which provided support and general information regarding technologies or costing were: the US Army Environmental Center; the National Defense Center for Environmental Excellence; the US Army Environmental Policy Institute; the US Army Research, Development, and Engineering Center; and the US Army Construction and Engineering Research Laboratory.

3-3. BUILD AND TEST THE PAPA INVESTMENT MODEL (PIM) (TASK 2)

a. This task involved designing, building, and testing a multiobjective, mixed integer, linear programming model. The PIM maximizes cost savings, energy savings, pollutant reduction, and minimizes investment/life cycle cost for individual or combinations of PPO. The PIM can explicitly account for budget constraints, pollution prevention goals, and economies of scale.

b. PIM develops and analyzes optimal pollution prevention investment strategies at Army facilities on an annual basis (what to buy, where, and when). PIM incorporates a multiobjective mixed integer programming approach in order to assimilate, analyze, and summarize the data needed for evaluating a range of pollution prevention measures among geographically and institutionally disparate Army facilities. The PIM mathematical programming approach used to evaluate the impacts of decision variables was ideally suited for producing the results needed to formulate investment strategies. PIM was structured to determine the PPO and site-specific investment strategy for applying any one or combination of the four possible alternative objective functions listed in Figure 3-3.

Model objective functions:	• Maximize cost savings • Maximize energy savings • Maximize pollutant reduction • Minimize investment/life cycle cost

Figure 3-3. PIM Objective Functions

c. The four objective functions defined for application in PIM expressed key environmental goals established by Army policy. PIM is capable of applying objective functions singularly or in combinations during processing. Depending upon policy and decisionmaking needs, a single or weighted grouping of objective functions is applied to govern development of investment strategies for maximizing the designated objective functions. While optimizing the selected objective functions, PIM calculates the impacts for each of the four objective functions (those selected for optimization and those not selected). PIM output specifies the PPO/site-specific economic and environmental impacts of implementing PPO measures and the total impacts for implementing all measures across all sites.

d. When two or more objectives are considered, they can be applied sequentially or weighted in a multiple function. The minimize cost objective is not intended to be used as a component of a run with maximize benefit components. It is recognized that the development of weights may be difficult and would likely require a discussion of the rationale behind their determination. It would involve the conversion to a single homogeneous unit of measure.

(1) Applying two objectives sequentially involves two optimization runs. In the first run, the primary objective is optimized. Then a constraint is added to the model that maintains the primary objective value achieved in the first run. The secondary objective is optimized in a run which must satisfy this constraint. In the case of more than two objectives, this process can be continued where each run must maintain the objective values achieved in the previous runs.

(2) Using a multiple objective function involves just one optimization run regardless of the number of component objectives involved. Each component objective is multiplied by a constant (weighted), then the sum is formed of the modified components to obtain the multiple objective function. Because this sum is a linear combination of linear objectives, it is linear.

(3) In general, the determination of whether and how to use sequential or weighted objectives is not a routine process. The resolution of these issues depends on context and on perceptions of the problems. It may involve substantial discussions between decisionmakers and analysts.

e. PIM imposes a budgetary constraint during processing. The budget constraint limits the total number of dollars which can be used to acquire PPO. Within this constraint, the model is free to calculate and develop the PPO site implementation sequencing plan which maximizes the selected objective function(s).

f. Figure 3-4 identifies the standard set of PPO data which were entered into the PIM to produce an investment strategy. Model logic fields were designated (expressed as equations) to reflect the objective functions to be applied during the model run. Assumed budget constraints were entered, as appropriate.

DATA	Initial and recurring costs of PPO
	Annual cost savings of PPO
	Annual energy savings of PPO
	Annual pollutant reduction of PPO
	Budget constraints (enter fiscal budget amounts)
LOGIC (EQUATIONS)	
	Objective functions (select from four options)

Figure 3-4. Standard Data Inputs Used by PIM in Developing PAPA Investment Strategies

g. Figure 3-5 identifies the standard set of data calculated and produced by the model for each PPO and site included in the run. Collectively, these data outputs comprise a comprehensive and detailed strategy for investing in all PPO at all sites in the precise order which maximized the selected objective function(s).

Investment by PPO and site
Annual implementation costs by PPO and site
Annual cost savings by PPO and site
Annual energy savings by PPO and site
Annual pollutant reduction by PPO and site

Figure 3-5. Standard Data Output from PIM

3-4. ANALYZE THE POLLUTION BASELINE AT SELECTED AMC INSTALLATIONS (BASE CASE) (TASK 3). The baseline for this study was established using AMC's 1992 Installation Hazardous Waste Generation Report. The figures used for the baseline reflect the volumes of hazardous wastes generated by industrial process. A total of 15 processes was tracked and reported, representing the standard industrial manufacturing processes found within AMC's industrial base. These figures do not include one-time generations such as spills, spill cleanup, residues, or closures of holding/treatment lagoons. They also do not include volumes of demilitarized conventional munitions other than actual wastes generated from the demilitarization process (e.g., propellant material, metal casings, projectiles, etc.). These amounts are not included because such hazardous wastes are not "generated" under the control of AMC but rather are a by-product of the demilitarization process itself. The pollution abatement and prevention opportunities which were input into the model were identified against the AMC-defined industrial hazardous waste stream generating processes. These figures are presented in Table 3-2 below.

Table 3-2. 1992 Waste Generation Baseline for Eight Sites

Site	Waste generation baseline (in kg) 1992
Anniston Army Depot	1,071,326
Corpus Christi Army Depot	505,619
Letterkenny Army Depot	817,241
Lone Star Army Ammunition Plant	4,600,228
Red River Army Depot	937,107
Tobyhanna Army Depot	146,072
Tooele Army Depot	639,159
Watervliet Arsenal	925,790

3-5. DEVELOP AND ANALYZE POLLUTION ABATEMENT AND PREVENTION INVESTMENT STRATEGIES (TASK 4)

a. This task involved applying the PAPA methodology to produce two Army pollution abatement and prevention strategies for a selected objective function, pollution prevention goal, and budget constraint. The investment strategies differed only by PPO considered, where one strategy utilized all identified PPO and the other used those having paybacks of 2 years or less. Payback was calculated by dividing initial cost by annual cost savings. The two investment strategies were formulated to present detailed site and PPO-specific acquisition plans (what to buy, where, and when). Also presented were the overall and site-specific economic and environmental impacts of implementing the strategies. In accomplishing this task, detailed site-specific PPO data and a pollution reduction goal (derived from Executive Order 12856) were used in conducting PIM runs to produce pollution abatement strategies. Model outputs were downloaded to a Microsoft EXCEL spreadsheet and the results summarized to illustrate generated investment strategies.

b. The two principal applications of the PAPA methodology were:

(1) What should the investment strategy be for 26 PPO at selected Army facilities in CONUS that maximizes pollution reduction and leads toward compliance with the 50 percent pollution reduction goal as set forth by Executive Order 12856?

(2) What should the investment strategy be for 10 PPO (of the 26 PPO with paybacks of 2 years or less) at selected Army facilities in CONUS that maximizes pollution reduction and leads toward compliance with the 50 percent pollution reduction goal as set forth by Executive Order 12856?

c. The pollution reduction objective function was invoked in the two applications above because of limitations in the data. Ideally, the applications would have required investment strategies that attained the pollution reduction goal at least cost. Review of the PAPA PPO data set revealed that in the aggregate, pollution reduction attained from the PPO was not sufficient to achieve the 50 percent goal. Thus, in these instances, the least cost objective function was irrelevant since the PIM always purchased all PPOs. Since the entire PPO data set was always acquired, waste stream reduction was maximized to achieve the most environmental benefit possible.

d. Investment cost minimization could have been done had the PPO data set been larger. Specifically, an appropriate number of PPO would have to be identified so that the total amount of pollution reduction exceeds the 50 percent elimination goal. If the data set had been sufficiently large, then the PIM would have produced a strategy that fulfilled the waste stream reduction goal at least cost. That is, PIM would acquire PPO in order of most pollution eliminated relative to investment cost.

e. The PAPA methodology was also applied in The Environmental Resources Programming Study (TERPS) which was performed by CAA for the Assistant Chief of Staff for Installation

Management (ACSIM). This analysis identified both PPO and ECO which had pollution reduction benefits formulating a combined investment strategy at Army facilities.

f. The PAPA methodology was demonstrated by addressing the two applications mentioned above. The purpose of these demonstrations was to illustrate the capability of the methodology. A representative PPO data set had been constructed with projects supplied from eight separate Army facilities.

(1) The basic approach used for the example applications was to maximize pollutant reduction (invoke the environmental objective function) while attempting to attain a 50 percent reduction in pollutant emissions, as indicated by Executive Order 12856. The two principal applications varied from this basic approach by the number of PPO considered. The first application considered all PPO identified in Task 2 of this study. Application 2 only utilized those PPO that had paybacks of 2 years or less.

(2) A total of 26 PPO from 8 different Army facilities composed the data set for the first application. These PPO are listed in Table 3-3. Appearing alongside the PPO in Table 3-3 are the Army installations where the PPO are to be applied.

Table 3-3. PPO of the PAPA Study - First Application

PPOs	Site
Vehicle hull blasting unit	Anniston Army Depot
Airframe paint stripping	Corpus Christi Army Depot
Laser rotor paint stripping	Corpus Christi Army Depot
Paint solvent recovery system	Corpus Christi Army Depot
Alum conv coating filtration system	Corpus Christi Army Depot
Replace chlorinated solvent degreasers	Corpus Christi Army Depot
Coolant recovery system upgrade	Corpus Christi Army Depot
Electrodialytic system	Corpus Christi Army Depot
Upgrade industrial waste treatment plant	Corpus Christi Army Depot
Deionize spray rinse systems	Corpus Christi Army Depot
Waterjet metal spray removal system	Corpus Christi Army Depot
Aqueous ultrasonic cleaning system	Corpus Christi Army Depot
Robotic waterjet paint/rust removal system	Corpus Christi Army Depot
Intermediate size plastic blasting media	Corpus Christi Army Depot
High pressure aqueous wash system	Letterkenny Army Depot
Line trough system integration (K-5)	Lone Star Army Ammunition Plant
Industrial sewer replacement	Lone Star Army Ammunition Plant
Sump and trough canopy system (Area B)	Lone Star Army Ammunition Plant
Sump and trough system installation (G-7)	Lone Star Army Ammunition Plant
Mechanical cleaning system	Lone Star Army Ammunition Plant
Treated waste water equipment installation	Lone Star Army Ammunition Plant
High pressure aqueous wash systems	Red River Army Depot
Electrodialysis plating system	Tobyhanna Army Depot
Organic washwater cleaning system	Tooele Army Depot
Electrodialysis plating solution recycling	Watervliet Arsenal
IONSEP electropolish solution recycling	Watervliet Arsenal

(3) The specific problem addressed in the first application was: "What should the investment strategy be for 26 PPO at selected Army facilities in CONUS that maximizes pollution reduction and leads toward compliance with the 50 percent pollution reduction goal as set forth by Executive Order 12856?" Key assumptions and parameters used for this first application were:

- Utilize 26 PPO from 8 CONUS Army installations.
- Timeframe of analysis is FY 1994 - FY 1999.
- Army program/budget for PPO acquisition is $2.02 million annually for FY 1994 - FY 1999.
- No economies of scale.
- All dollars are expressed in FY 1994 constant dollars.

(4) The total investment cost of purchasing all 26 PPO at the 8 installations was annualized between FY 1994 and FY 1999, resulting in six equal annual budgets of $2.02 million. Based upon these budgets, PIM was used to generate a detailed investment strategy for acquiring all PPO at all facilities by FY 1999. The pattern of the PPO acquisition strategy generated by the model led to a key observation. This observation was that during PPO acquisition, PIM considered the relative investment cost in comparison to the pollutant reduction associated with a PPO. That is, PIM would acquire PPO with the greatest pollutant reduction per invested dollar first. Table 3-4 shows PPO implementation of the first application. Appendix E of this study gives a more detailed account of this topic.

(5) Table 3-5 summarizes selected model results for the first application involving all 26 PPO. Model output for the FY 1994 - FY 1999 study period, as well as life cycle impacts, are presented. The second column in Table 3-5 lists the results for the FY 1994 - FY 1999 study period, under an investment strategy which maximizes pollution reduction. A cost savings of $15.5 million was generated over the study period from a total investment of $12.1 million. This was a return of $1.28 for each dollar invested. Pollutant emission reduction amounted to 3.02 million kilograms, and energy savings totaled 2.44 million kilowatt-hours.

Table 3-4. Implementation of PPOs

PPOs	FY 94	FY 95	FY 96	FY 97	FY 98	FY 99
Vehicle hull blasting unit		1				
Airframe paint stripping					1	
Laser rotor paint stripping						1
Paint solvent recovery system	1					
Alum conv coating filtration system	1					
Replace chlorinated solvent degreasers	1					
Coolant recovery system upgrade	1					
Electrodialytic system	1					
Upgrade industrial waste treatment plant				1		
Deionize spray rinse systems		1				
Waterjet metal spray removal system			1			
Aqueous ultrasonic cleaning system			1			
Robotic waterjet paint/rust removal system						1
Intermediate size plastic blasting media	1					
High pressure aqueous wash system				1		
Line trough system integration (K-5)			1			
Industrial sewer replacement				1		
Sump and trough canopy system (Area B)	1					
Sump and trough system installation (G-7)				1		
Mechanical cleaning system	1					
Treated waste water equipment installation		1				
High pressure aqueous wash systems		1				
Electrodialysis plating system	1					
Organic washwater cleaning system	1					
Electrodialysis plating solution recycling			1			
IONSEP electropolish solution recycling	1					

Note: for site location, see Table 3-1.

Table 3-5. Selected Output for First Application (26 PPO)

Objective	Cumulative FY 94 - FY 99 impacts	Cumulative life cycle impacts
Investment cost	$ 12.1 million	$ 12.1 million
Pollution reduction (kg)	3.02 million	8.11 million
Cost savings	$ 15.5 million	$ 56.8 million
Energy savings (kWh)	2.44 million	4.91 million

(6) The third column in Table 3-5 lists the life cycle impacts of the investment strategy which maximizes pollution reduction. It should be noted that the average economic life of the PAPA PPO was 15 years. A cost savings of $56.8 million was obtained from a total investment of $12.1 million. This amounts to a return of $4.69 for each dollar invested. Life cycle pollutant emissions were reduced by 8.11 million kilograms, and energy reduction was 4.91 million kilowatt-hours.

(7) While the pollution reduction listed in Table 3-5 is significant, it amounts to only a fraction of the reduction required to satisfy Executive Order 12856. In calendar year (CY) 1992, the eight Army facilities utilized for the first application (see Table 3-3) released 9.64 million kilograms of pollutants. To comply with Executive Order 12856, 50 percent (4.82 million kilograms) of the pollutants released by the eight installations would have to be eliminated. After implementation of all the PPO from Table 3-3, the annual pollution reduction is 0.58 million kilograms. This annual pollutant elimination of 0.58 million kilograms is 4.24 million kilograms short of the 50 percent reduction goal. That is, the investment strategy summarized in Table 3-5 (application number one) achieved 12 percent of the goal set forth by Executive Order 12856.

(8) Plotted in Figure 3-6 is the pollution reduction obtained from the first application (PPO of Table 3-3). Appearing in the figure are the CY 1992 pollutant generation for the eight facilities (pollutant baseline), the 50 percent reduction goal of Executive Order 12856, and the actual pollutant reduction produced by the first application's investment strategy. As Figure 3-6 shows, the investment strategies' projected pollution reduction is well above the 50 percent elimination goal.

(9) The second application applied an additional criteria to the basic approach. Specifically, of the 26 PPO listed in Table 3-3, only those with paybacks of 2 years or less were considered. This criteria narrowed the PPO data set to 10 projects. These 10 PPO appear in Table 3-6. Presented with the PPO in Table 3-6 are the location of the project, and its payback. Similar to the first application, half of the PPO come from Corpus Christi Army Depot. PPO are rank-ordered by payback in Table 3-6.

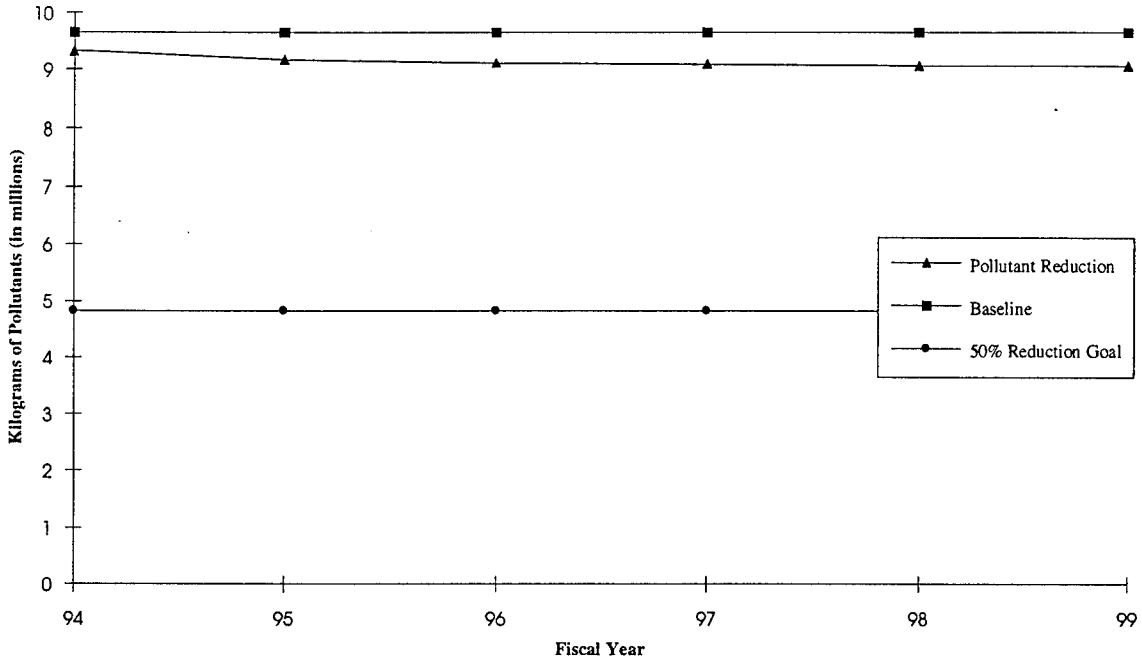


Figure 3-6. Pollutant Reduction vs Baseline and Reduction Goal

Table 3-6. PPO With 2-year or Less Payback - Second Application

PPO	Payback in years	Site
High pressure aqueous wash systems	1.84	Red River Army Depot
Electrodialysis plating solution recycling	1.71	Watervliet Arsenal
Aqueous ultrasonic cleaning system	1.66	Corpus Christi Army Depot
Organic washwater cleaning system	1.54	Tooele Army Depot
Paint solvent recovery system	1.34	Corpus Christi Army Depot
Intermediate size plastic blasting media	1.32	Corpus Christi Army Depot
Mechanical cleaning system	1.18	Lone Star Army Ammo Plant
Electrodialysis plating system	1.13	Tobyhanna Army Depot
Deionizing spray rinse systems	1.07	Corpus Christi Army Depot
Waterjet metal spray removal system	0.71	Corpus Christi Army Depot

(10) The specific problem addressed in the second application was: "What should the investment strategy be for 10 PPO (of the 26 PPO with paybacks of 2 years or less) at selected Army facilities in CONUS that maximizes pollution reduction and leads toward compliance with the 50 percent pollution reduction goal as set forth by Executive Order 12856?" Key assumptions and parameters used for this second application were:

- Utilize PPO with paybacks of 2 years or less.
- Timeframe of analysis is FY 1994 - FY 1999.
- Army program/budget for PPO acquisition is $2.02 million annually for FY 1994 - FY 1996.
- No economies of scale.
- All dollars are expressed in FY 1994 constant dollars.

(11) In the second application, the total investment cost of purchasing all 10 PPO was shortened to three fiscal years (FY 1994 - FY 1996). Utilizing the same annual budget as in application one, a budget constraint of $ 2.02 million per fiscal year was set. Since the annual expenditure on PPO acquisition could not exceed $2.02 million in any fiscal year, the three annual expenditures were of unequal size. Only in FY 1994 was the total available budget of $2.02 million actually spent. Due to the investment cost of some PPO, the expenditures in the remaining two fiscal years was less than the total budget available.

(12) Based upon the budget constraint mentioned above, PIM generated a detailed investment strategy for acquiring the 10 PPO of Table 3-6. Similar to the first application, PIM acquired PPO with the greatest pollutant reduction per invested dollar first.

(13) Table 3-7 displays model results for the second application. Model output for the FY 1994 - FY 1999 study period, as well as life cycle impacts, are listed. The second column in Table 3-7 presents the results for the FY 1994 - FY 1999 study period, under an investment strategy which maximizes pollution reduction. A cost savings of $15.3 million was generated over the study period from a total investment of $3.02 million. This was a return of $5.07 for each dollar invested. Pollutant emission reduction amounted to 1.31 million kilograms, and energy savings totaled 1.69 million kilowatt-hours.

(14) The third column in Table 3-7 presents the life cycle impacts of the second application. Second application PPO had an average economic life of 15 years. A cost savings of $35.9 million was obtained from a total investment of $3.02 million. This amounts to a return of $11.89 for each dollar invested. Life cycle pollutant emissions were reduced by 3.80 million kilograms, and energy reduction was 2.14 million kilowatt-hours.

Table 3-7. Selected Output for Second Application (10 PPO)

Objective	Maximize pollution reduction case FY 1994 - FY 1999	Life cycle impacts
Investment cost	$3.02 million	$3.02 million
Pollution reduction (kg)	1.31 million	3.80 million
Cost savings	$15.3 million	$35.9 million
Energy savings (kWh)	1.69 million	2.14 million

CHAPTER 4

FINDINGS AND RECOMMENDATIONS

4-1. INTRODUCTION. This chapter summarizes the PAPA Study's key findings and recommendations. During the conduct of this study, additional data were discovered which are beyond the stated scope and objectives. Although they are not directly related to the PAPA methodology, they are significant enough to warrant inclusion in this report. This chapter provides a short discussion of the findings followed by related recommendations.

4-2. FINDINGS AND RECOMMENDATIONS. The following are the key PAPA findings and recommendations.

a. The PAPA methodology satisfies the Army's need for a quick turnaround decision support capability that can develop and evaluate investment strategies to prevent or reduce pollution, reducing operating and compliance costs, and comply with Army environmental policy objectives. The PIM solution for the base case scenario shows that the methodology can be applied to identify strategies to satisfy policy requirements, specifically Executive Order 12856. It integrates PPO technology, cost, benefit, and waste stream data to produce an investment strategy and provide summary data by objective function. As an automated system, it can rapidly respond to program requirements and changes without being resource-intensive.

Recommendation. The PAPA methodology should be used as a management tool by decision-makers at all levels to develop and evaluate investment strategies to prevent or reduce pollution, reduce operating costs, and support the requirements of Executive Order 12856.

b. The scope of the study required PPO technologies be identified which are in research, development, demonstration, and commercialization. As discussed in Chapter 2, the study team encountered difficulty in identifying pollution abatement and prevention opportunity information from existing program management and information files. Input data required by the PIM did not exist in the RCS 1383 data base. The PPO technology and data characteristics therefore had to be obtained directly from the demonstration sites. The PPO data identified and collected in Chapter 3 were tied directly to the sites' reported waste streams. This facilitated accomplishing Tasks 1 and 3 concurrently for the demonstration sites. However, since the PPO data were site- and waste stream-specific, they could not be applied on a broader basis. Investment strategies for the Army as a whole could not be developed from this sample data set. The additional PPO data obtained from the IOC (CTX) office was also found to be site- and waste stream-specific. Reviewing the Army's Environmental Strategy Action Plan, the team also found that the projects reflected were those submitted by the MACOMs only, not based on technology sharing/transfer or on a long-range investment strategy. A more fully developed program data base, coupled with a capability to develop a centrally managed investment program focused on policy and "what is best for the Army," would provide an opportunity for a wider application of PPO technology and improve the long-range planning process. If effectively implemented, it can provide decisionmakers with the ability to better develop and assess "cause and effect" impacts

of various policy changes and investment strategies supporting long-range environmental program objectives.

Recommendation. The PAPA methodology should be used as a planning and programming tool by senior Army management to support the development of a more fully integrated and defensible environmental program. Pollution abatement and prevention investment projects, articulated with cost/benefit data, could be incorporated in the Army's Environmental Strategy Action Plan as investment rather than compliance issues.

c. The RCS 1383 data base could not be used as a source to obtain PPO technology data to feed the PIM. Although it is currently the most comprehensive source of data supporting the Army's environmental program, it lacks the required critical cost/benefit and waste stream/chemical data required to make business-focused investment decisions. Benefit data, in terms of cost savings, energy savings, and, most importantly, pollution reduced as a result of the project is critical in order to develop sound investment strategies. Description of the waste stream/chemical being addressed is also significant when determining if opportunities exist for applying the same technology to similar waste streams at other installations. The addition of project-specific life cycle cost/benefit and waste stream/chemical identification data within each of the program pillars would enhance the utility of RCS 1383 and provide a more complete data source for more integrated and long-range program planning. This data should be updated concurrent with the routine RCS 1383 submissions in order to maintain timeliness and accuracy for potentially broader application.

Recommendation. Project data should be developed and collected within each program pillar. Data identifying the waste streams/chemicals being addressed and project life cycle costs and benefits should be added and regularly updated to the data base files of the RCS 1383 Environmental, Pollution Prevention, Control, and Abatement Report.

d. The PAPA methodology is inherently flexible and transferable such that it can readily incorporate changes in policy, budgetary, and technical data elements to develop and evaluate investment strategies. The generic nature and transferability of the methodology is shown during Task 2 and again in The Environmental Resources Programming Study (TERPS), which used energy conservation opportunity data from the REEP Study to develop pollution abatement and prevention investment strategies. In TERPS, the PAPA methodology blended both PPO and ECO data and developed an integrated investment strategy. The alternate investment strategy developed in Chapter 3, based on a 2-year investment payback criterion, demonstrates the flexibility of the model to accept various decision variables using a common data set. In this case, it was a financial consideration constraint. Investment strategies are not limited to facility type projects only, but can be developed where investment costs and benefits can be measured and input into the PIM. Two additional potential applications of the methodology were identified by senior management from AMC and the Office of the Directorate of Environmental Programs (ODEP) in the areas of material specification reviews and development of long-range environmental research and development programs, respectively. This further supports the potential application of the PAPA methodology across all of the Army's environmental program pillars.

Recommendation. Army managers should use the PAPA methodology and the cost/benefit output to better define and develop long-term environmental program management projects, focused on meeting future Army objectives.

e. The PAPA methodology provides Army management a practical tool to assess broad impacts of policy changes and develop and evaluate environmental program requirements focused on achieving the Army's objectives. Planners can assess various pollution abatement and prevention technologies or opportunities to determine varying magnitudes of benefits based on identified fiscal or programmatic constraints. Results can then be analyzed and used to establish centrally managed program objectives, setting policies for implementation at MACOM and installation locations. Included in the analysis, planners can determine whether program objectives can be met and at what cost, or establish refined objectives that are within the resources available. The PAPA methodology could also be used as an aid in analyzing the development and impacts of new policy. The ability to quantify the potential benefits at the Army level helps to better justify resource requirements "up" and allocation "down" to the MACOMs for program execution, helping to support long-range planning and policy compliance requirements. Information produced by this program support tool would be invaluable for building and defending the environmental portion of the Army POM.

Recommendation. The PAPA methodology should be used as a management tool to assess broad impacts and implications of environmental policy changes. It could also be used in support of environmental policy development and evaluation in the Army.

f. Although not recorded in data base files, the study team found that cost/benefit data for pollution abatement and prevention investment projects did exist. During the site visits discussed in Chapter 3, the study team collected this data from economic analysis documents both at the installation and at the major subordinate command (IOC). Since the project and data was site- and waste stream-specific, it was not forwarded through the chain of command for a broader based cost/benefit analysis. The information was held as a justification document for the individual project at the project initiation site. Only when dollar values of the project exceeded established thresholds were the projects forwarded to the next level of command. They were then reviewed from an economic justification basis. A tool which could rapidly evaluate the technology and cost/benefit applications of PPOs across installations would greatly enhance commanders' abilities to respond to Regulator inspections and/or environmental compliance audits. Site-specific information on audit findings, appropriate technology, and/or corrective action opportunity data (with cost/benefits) can be input into the methodology and processed with real-time program or resource constraints. Investment strategies can then be produced for analysis and incorporated into corrective action compliance plans and implementation schedules. Resource requirements can then be identified with quantifiable data supporting the technical information, providing complete justification packages.

Recommendation. Cost/benefit data generated by the PAPA methodology should be used by commanders to better define and develop their pollution abatement and prevention investment projects and support installation-level environmental program compliance plans for corrective action.

g. Although not stated in the study scope or objectives, the study team found that unexpected or unanticipated costs (e.g., notices of violation, Federal Facility Compliance Act enforcement, etc.) which occur during the execution year are considered "operating costs." This was discussed during numerous meetings between the study team, HQ AMC, ODEP, and AEC. By Army policy, these costs must be borne by the MACOM from within their programmed operations and maintenance (O&M) account. Since fewer discretionary dollars are available in the command's annual operating budget, and these are environmental issues, the normal source to cover these costs are the environmental dollars programmed above the "must fund" line (Class II-O). These are generally dollars requested by the commander for specific investment or preventive projects, often required to preclude a "must fund" or compliance requirement in the future. The programming, then "taking away," of the budgeted dollars becomes a disincentive for commanders to request funds for long-term investment projects. In most cases, these unexpected or unprogrammed requirements are beyond the commander's direct control. Under the provisions of the 1992 Federal Facility Compliance Act, these costs will continue to increase. The result is that fewer dollars are available for long-term pollution abatement and prevention investment projects. Failure to make these type investments now will cause them to become compliance requirements in the future, especially with respect to the Executive Order requirements.

Recommendation. There currently is no programmatically feasible solution to this issue.

APPENDIX A

STUDY CONTRIBUTORS

1. STUDY TEAM

a. Study Director

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APPENDIX B

STUDY DIRECTIVE

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
INSTALLATIONS LOGISTICS AND ENVIRONMENT
110 ARMY PENTAGON
WASHINGTON, DC 20310-0110

REPLY TO ATTENTION OF:
DASA-ESOH (5-5d)

DEC 30 1993

MEMORANDUM FOR DIRECTOR, U.S. ARMY CONCEPTS ANALYSIS AGENCY, ATTN: CSCA-FSR, 8120 WOODMONT AVENUE, BETHESDA, MARYLAND 20814-2797

SUBJECT: Pollution Abatement and Prevention Analysis (PAPA) Study Directive

1. PURPOSE OF STUDY DIRECTIVE. This directive tasks the U.S. Army Concepts Analysis Agency (CAA) to develop and demonstrate an analytical methodology for evaluating the costs and benefits of investing in pollution abatement and prevention opportunities supporting U.S. Army activities and facilities.

2. STUDY TITLE. Pollution Abatement and Prevention Analysis (PAPA) Study.

3. BACKGROUND

a. The U.S. Congress, in the Pollution Prevention Act of 1990, established a hierarchy for pollution management as a matter of national policy. It declared that pollution should be prevented or reduced at the source whenever feasible; if not prevented or reduced, recycled in an environmentally safe manner; when not prevented, reduced, or recycled, then treated in an environmentally safe manner; and only as a last resort, safely disposed of or released into the environment.

b. On 3 August 1993, the President signed Executive Order #12856, entitled "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements." It establishes the Federal government as the leader in pollution prevention and requires compliance with Sections 301 thru 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA). Included in this Executive Order is the requirement for each Federal agency who owns or operates facilities (to include the Army) to develop a pollution prevention strategy that will achieve a 50 percent reduction in release and off-site transfer of toxic chemicals by 31 December 1999.

c. Confirming the Army's commitment to protecting our environment, the Chief of Staff issued a personal memo dated 24 August 1993 to each of his MACOM Commanders. In the memo, he directed each commander to: comply with Federal, state and local environmental standards and policies; incorporate environmental procedures into Army operations; clean contaminated sites; and, prevent future pollution. He reemphasized his goal for the Army to be a national leader in environmental stewardship.

d. The Army requires a quick turnaround decision support capability that can develop and evaluate investment strategies to prevent or reduce pollution, reduce operating compliance costs, and comply with Army environmental policy. An analytical methodology will be developed and demonstrated in this study that can logically incorporate factors of environmental policy, cost, technical performance, budget constraints, industrial processes, and facility characteristics to support the pollution prevention policy decisionmaking process.

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4. STUDY SPONSOR. The Assistant Secretary of the Army for Installations, Logistics, and Environment (ASAIL&E).

5. TERMS OF REFERENCE

a. Purpose. To develop and demonstrate an analytical methodology for evaluating the costs and benefits of investing in pollution abatement and prevention opportunities supporting U.S. Army activities and facilities.

b. Definitions. For the purpose of this study, the following definitions apply:

(1) Pollution Abatement. The use of materials, processes, or practices that reduce the degree or intensity of, or eliminate, pollution.

(2) Pollution Prevention. The use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. Included are practices that reduce the use of hazardous materials, energy, water or other resources and practices that protect natural resources through conservation or more efficient use.

(3) Toxic Materials. Any substances that contains chemicals described in section 313(c) of Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986. This list contains approximately 336 chemicals, selected by Congress, which impose a health hazard due to their chronic or long-term toxicity.

c. Scope

(1) Application timeframe for analysis is FY 94 thru FY 01.

(2) Army activities and facilities in the continental United States (CONUS) only.

(3) Toxic chemicals described in section 313(c) of EPCRA.

(4) Pollution abatement and prevention opportunities and activities that are in research, development, demonstration and commercialization.

(5) Selected case studies jointly identified with study sponsor will be used to demonstrate the methodology.

d. The objectives are:

(1) Identify and evaluate pollution abatement opportunities.

(2) Identify and evaluate pollution prevention opportunities.

(3) Develop an analytical capability to generate and evaluate pollution abatement and prevention investment strategies supporting U.S. Army activities and facilities.

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(4) Develop and analyze pollution abatement and prevention investment strategies at selected CONUS U.S. Army facilities.

6. RESPONSIBILITIES

a. The study sponsor will:

(1) Provide a study point of contact (POC).

(2) Assist in providing CAA with available data and points of contact as required.

(3) Prepare an analysis of study results IAW AR 5-5, Army Studies and Analyses.

(4) Establish a Study Advisory Group (SAG). Schedule in-process reviews as required.

b. The study agency, CAA, will:

(1) Designate a study director and establish a full-time study team.

(2) Establish direct communication with HQDA and other organizations required for the conduct of the study.

(3) Provide in-process reviews as requested and a final study report to the study sponsor.

7. ADMINISTRATION

a. CAA will provide all administrative support necessary for the conduct of the study.

b. Environmental data for this study will be obtained from or through the study sponsor. Data requirements will be identified by CAA (and study sponsor as appropriate).

c. Milestone Schedule

Approval of Study Directive	Dec 93
In-process Reviews	As Req
Present Study Results	Jul 94
Publish Final Report	Nov 94

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d. CAA, in coordination with the sponsor, will prepare the initial DD Form 1498, Research and Technology Work Unit Summary.

e. CAA will provide study results to the study sponsor as a study report.

f. This tasking directive has been coordinated with CAA IAW paragraph 4, AR 10-38, United States Army Concepts Analysis Agency.

Lewis D. Walker
Deputy Assistant Secretary of the Army
(Environment Safety and Occupational Health)
OASA (I, L&E)

APPENDIX C

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APPENDIX D

MATHEMATICAL DESCRIPTION OF THE PAPA INVESTMENT MODEL

D–1. INTRODUCTION. This appendix presents a formal technical description of the core methodology of the investment model for PAPA. It is based on the REEP methodology which is mathematically described in Appendix D of the REEP study report. This report has been extensively reviewed both in and outside this agency. The postprocessing equations, which are found on the spreadsheets, are not presented here as they are never seen by the optimizer. (A main function of the postprocessing equations is to convert percentage results into quantity values.)

D–2. INDEX USAGE

a. Upper Limits and Indices

(1) S Total number of sites.

(2) s Site index, where $s = 1,2,...,S$.

(3) E Total number of different PPO.

(4) e PPO index, where $e = 1,2,...,E$.

(5) T Total number of years in the planning period.

(6) t Planning year index, where $t = 1,2,...,T$.

(7) i Objective function component (Paragraph D-6b), where $i = 1,2,3$.

b. Note on the Dimensionality of the Study. In the core spreadsheets configuration, the total numbers S, E, and T of sites, PPO, and planning years are respectively 3, 50, and 6. The 6 planning years are from FY 94 through FY 99. It was originally intended to collect data for up to 50 PPO at 3 representative sites. However, it developed that data was currently obtainable for 27 PPO at 9 sites. More importantly, each PPO had data for only one site; thus, given results regarding an ECO, it is known to what site these results apply. So from a mathematical point of view, it is not necessary, at present, to extend the model from three to nine sites. (The nature of the data, however, required a radical change in the treatment of the cumulation variables which determine benefits. This is discussed further below.)

D–3. DATA

a. PPO-specific Data

(1) IC_{se} Initial cost for a 100 percent replacement of old technology at site s by PPO e.

(2) CS_{se} Annual cost savings from a 100 percent replacement of old technology at site s by PPO e

(3) ES_{se} Annual energy savings from a 100 percent replacement of old technology at site s by PPO e.

(4) VS_{se} Annual environmental savings (pollution abated) from a 100 percent replacement of old technology at site s by PPO e.

(5) RP_{se} Remaining fraction investment potential at the start of the planning period at site s of PPO e. (For the all current PPO, this potential at the start was 100 percent.)

b. Budget Data

(1) BG_t Budget for year t.

(2) RO fraction of the previous year's cost savings that can be rolled over to supplement current year's budget.

c. Objective Function Data

(1) W_i Weight of objective function component.

(2) XVS Indicates the objective function result from a maximized pollutant reduction optimization to be maintained in a subsequent cost savings maximization. The purpose of the second optimization is to maximize cost savings without lowering the previously achieved pollutant reduction.

D–4. DECISION VARIABLES

- X_{set} Fraction of the total quantity at site s of PPO e invested in during year t. (Total quantity includes the amount invested in the new technology PPO by the start of the planning period.)

D–5. CUMULATIVE ADDITIONAL FRACTION INVESTMENT. Most of the expressions below involve CU_{set}, the cumulative additional fraction investment at site s in PPO e through year t..

a. Current Method. A CU_{set} is a binary variable which is allowed to be 1 only when a PPO at a site is completely bought. This was necessary because a PPO has only one implementation; thus, a partial investment does not supply benefits. On the other hand, energy conservation opportunities (ECO), such as using high efficiency ventilation motor, for example, have many opportunities at a given site; thus, a benefit can be obtained from investing in a fraction of those available at a site.

b. Previous Method. CU_{set} was a real variable defined as follows:

$$\text{For } s = 1,...,S \; ; \; e = 1,...,E \; ;$$

$$CU_{set} = \begin{cases} X_{set} & t = 1 \\ CU_{se(t-1)} + X_{set} & t = 2,...,T. \end{cases}$$

This definition was not used in PAPA. It would be applied where savings are obtained from a partial implementation of a PPO. This would be the case for example if a PPO involved replacing lighting fixtures.

D–6. OBJECTIVE FUNCTIONS

a. Minimize Cost. This objective function is

$$\text{Minimize} \sum_{t=1}^{T}\sum_{e=1}^{E}\sum_{s=1}^{S} IC_{se}X_{set}$$

b. Maximize Benefits. This objective function is

Maximize

$$W_1\sum_{t=1}^{T}\sum_{e=1}^{E}\sum_{s=1}^{S} CS_{se}CU_{set} + W_2\sum_{t=1}^{T}\sum_{e=1}^{E}\sum_{s=1}^{S} ES_{se}CU_{set} +.$$

$$W_3\sum_{t=1}^{T}\sum_{e=1}^{E}\sum_{s=1}^{S} VS_{se}CU_{set}$$

Often, in practice, the weights of two of the three components are each zero, so that the objective function is equivalent to one of the following:

(1) Maximize Cost Savings

$$\text{Maximize} \sum_{t=1}^{T}\sum_{e=1}^{E}\sum_{s=1}^{S} CS_{se}CU_{set}.$$

(2) Maximize Energy Savings

$$\text{Maximize} \sum_{t=1}^{T}\sum_{e=1}^{E}\sum_{s=1}^{S} ES_{se}CU_{set}.$$

(3) Maximize Pollutant Reduction

$$\text{Maximize} \sum_{t=1}^{T}\sum_{e=1}^{E}\sum_{s=1}^{S} VS_{se}CU_{set}.$$

c. Comments

(1) The minimize cost objective is not intended to be used as a component of a run with maximize benefit components.

(2) It is recognized that the development of weights may be difficult and would likely require a discussion of the rationale behind their determination. It would involve the conversion to a single homogeneous unit of measure.

(3) Effects among the PPO are not considered. The possible interactions of different PPO in the waste stream are not taken into account. It may be that such considerations could require a non-linear process.

D–7. CONSTRAINTS

a. Annual Investment Dollar Constraints

$$\sum_{e=1}^{E}\sum_{s=1}^{S} IC_{se}X_{set} \le \begin{cases} BG_t & t=1 \\ BG_t + RO * \sum_{e=1}^{E}\sum_{s=1}^{S} CS_{se}CU_{se(t-1)} & t=2,...,T. \end{cases}$$

b. Total Planning Period Investment Limited by Remaining Potential at Start

$$CU_{seT} \le RP_{se} \quad \text{For } s = 1,...,S \text{ ; } e = 1,...,E \text{ ;}$$

c. Binary Constraints. "Cumulation fraction less than or equal sum of investment fractions"

$$CU_{set} \le X_{se1} + X_{se2} + ... + X_{set}$$
$$\text{For } s = 1,...,S \text{ ; } e = 1,...,E \text{ ; } t=1,...T.$$

d. Maintain First Objective. (Example of optional sequential programming to improve a secondary objective function while maintaining the primary objective function value found in the initial optimization.)

$$\sum_{t=1}^{T}\sum_{e=1}^{E}\sum_{s=1}^{S} VS_{se}CU_{set} \ge XVS.$$

APPENDIX E

SPREADSHEET IMPLEMENTATION OF THE INVESTMENT MODEL

E-1. INTRODUCTION. This appendix provides brief examples of the Excel 4.0 spreadsheets of the investment model and an indication on how spreadsheet information is relayed to the optimizer. The PAPA Investment Model (PIM) resides on 51 spreadsheets. For each of 50 projected PPO, there is a spreadsheet containing data and logic specific to that PPO. The 51st or main spreadsheet contains links to the other 50 spreadsheets.

E-2. SPREADSHEET ORGANIZATION. A very brief overview of the investment model spreadsheets is given here. See the REEP Study Report (CAA-SR-93-7) for an extensive discussion.

a. PPO Spreadsheets. Table E-1 has an example of a spreadsheet specific to a single PPO. Using the Excel outline utility, some rows have been hidden to keep the spreadsheet on one page without excessive size reduction. The numbers in rows 34, 38, and 42 are sent to the main spreadsheet. For example the value "212" in row 34, column E, is summed with the values from the same cell of each of the other 49 PPO spreadsheets to yield a total annual investment cost on the main spreadsheet Some brief notes on some sections of the spreadsheet follow. This is not intended to be a full discussion

(1) Cells C11, C12 and C13 contain the quantity of opportunities. These numbers are always 0 or 1 for the current data set.

(2) Area D11:D13 (Cells D11, D12, and D13) contains the cost of fully implementing the PPO at the indicated site. Area E11:G13 (Areas E11:E13, F11:F13, and G11:G13) contains data on the beneifts of fully implementing the PPO.

(3) The technical constant in Cell H11 provides on upper bound on the fraction of the PPO that can be implemented in the planning period. A "1" here indicates that no part of the PPO was implemented before the start of the planning period.

(4) The remaining cells (except for comment cells) pertain to decision variables or formulas which are discussed in Appendix D

(5) As the trust of the PAPA runs was to maximize pollutant reduction or cost savings, the formulas involving energy saving were put in postprocessing (lower) part of the spreadsheet. The formulas in this part were not sent to the optimizer.

b. Main Spreadsheets. Table E-2 has an example of a main spreadsheet. The total annual investment cost mentioned above is in cell E28. The data and logic that pertain to the PPO as a group reside on the main spreadsheet. For example, row 16 contains budget data. Row 38 contains the pollutant reductions obtained from all the PPO. The cells (except for comment cells) above Row 21 contain data; those below Row 21 contain formulas. The formulas (links) that obtain the energy savings from the PPO spreadsheets are in the postprocessing (lower) part of the spreadsheet.

Table E-1. Snapshot of F01

	A	B	C	D	E	F	G	H	I
1		intssug7Install Trough System and Sumps, G-7					Costs are in 1000s of dollars		
2							Pollutant Reduction is in 1000s of kg		
3							Energy is in 1000s of kwh		
7									
8			Quantity	Init Cost	Annual	Annual	Annual	Technical	Investment
9			of Oppor-	of	Cost Sav	Pol Prev	Energy Sav	constants	Fract Left
10	Code	Names	tunities	full inv	full inv	full inv	full inv	used in eqns	(not data)
11	S01	CORPUS CH	0	0	0	0	0	1	1
12	S02	LONESTAR	1	212	5	2	0		0
13	S03	WATERVLI	0	0	0	0	0		1
14									
15	total or max		1	212	5	2	0		
18			Decision cells						
19			Group 1 - Fraction Investment						
20			Group 2 - Cumulation based 0/1 cells						
21			fy94	fy95	fy96	fy97	fy98	fy99	
22	S01	CORPUS CH	0	0	0	0	0	0	
23	S02	LONESTAR	0	0	1	0	0	0	
24	S03	WATERVLI	0	0	0	0	0	0	
25	S01	CORPUS CH	0	0	0	0	0	0	
26	S02	LONESTAR	0	0	1	1	1	1	
27	S03	WATERVLI	0	0	0	0	0	0	
28									
29									
30			The Total lines below are linked to MAIN						
31									
32			Annual Investment Costs			In 1000s of dollars			
33			fy94	fy95	fy96	fy97	fy98	fy99	
34		Total	0	0	212	0	0	0	
35									
36			Annual Cost Savings			In 1000s of dollars			
37			fy94	fy95	fy96	fy97	fy98	fy99	
38		Total	0	0	5	5	5	5	
39									
40			Annual Pollution Prevention			In 1000s of kg			
41			fy94	fy95	fy96	fy97	fy98	fy99	
42		Total	0	0	2	2	2	2	
43									
44			Sum to date of procurement dec cell						
45			(for use in 0/1 constraints below)						
46			fy94	fy95	fy96	fy97	fy98	fy99	
47			see above	0	0	0	0	0	
48			see above	0	1	1	1	1	
49			see above	0	0	0	0	0	
50									
51			Constraints on the 0/1 cells						
52			fy94	fy95	fy96	fy97	fy98	fy99	
53	S01	CORPUS CH	0	0	0	0	0	0	
61			Annual Energy Savings			In 1000s of Mbtu			
62			fy94	fy95	fy96	fy97	fy98	fy99	
63		Total	0	0	0	0	0	0	
69	end		end						

Table E-2. Snapshot of Main

	A	B	C	D	E	F	G	H	I
8			DATA						
9									
10			Minimum annual pollution prevention required in fy99						
11			0						
12			Fraction for cost savings rolled over						
13			0						
14			Annual investment funding limitations (Budget) in 1000s of dollars						
15			fy94	fy95	fy96	fy97	fy98	fy99	
16		Budget	2018.45	2018.45	2018.45	2018.45	2018.45	2018.45	
17									
18			Weights for objectives(-1 will min) & values of 2nd run sav requirements						
19			Inv Cost	CS	EnvirS				
20			0	1	0				
21					3019.809				
22			LOGIC						
23			**Multiple Objective Function**						
24			(for interior pt method, remove variables with zero coeff)						
25			15472.07						
26									
27			Total annual investment costs						
28			2018.45	2018.45	2018.45	2018.45	2018.45	2018.45	
29			**Grand total investment costs (1000s of dollars)**						
30			12110.7						
31									
32			Total annual cost savings						
33			974.895	1900.895	2532.595	2768.895	2860.895	4433.895	
34			**Grand total costs savings (1000s of dollars)**						
35			15472.07						
36									
37			Total annual pollution prevention						
38			323.356	466.456	526.226	550.996	575.349	577.427	
39			**Grand total pollution prevention (1000s of kilograms)**						
40			3019.81						
41									
42			Enforcement of minimum pollution prevention requirement by fy99						
43			577.427						
44									
45			Annual budget + cost savings rolled over from previous year						
46			fy94	fy95	fy96	fy97	fy98	fy99	
47			see budget	2018.45	2018.45	2018.45	2018.45	2018.45	
48									
49			Enforcement of cost limit						
50			unused amount shown						
51			fy94	fy95	fy96	fy97	fy98	fy99	
52			0	0	0	0	0	0	
53			Enforcement of requirements						
54				CS	EnvirS				
55					0.001				
56			**LINKS- Total annual investment costs by PPO**						
112			**LINKS - Total annual cost savings by PPO**						
168			**LINKS - Total annual pollution prevention by PPO**						
222			**postprocessor**						
229			**LINKS - Total annual energy savings by PPO**						
392	end								

E-3. RELAY

a. Example 1 below contains the first three formulas of the main spreadsheet as picked out by Relay, the C++ optimization matrix generator for CAA investment models. Relay automatically handles many spreadsheets structures linked as in REEP and PAPA. That is, no additional C++ coding is required to generate the optimizer input when many types of logic changes are made to the spreadsheets.

b. The first formula in Example 1 pertains to the objective function in cell C25. Examples 2 and 3 contain preliminary and final preparations of the objective function information for the optimizer. A "d" in Example 2 indicates data and "dC20" mean the data in C20. In Example 3, the actual data,"0", is given. The row and column names and numbers in Example 2 are unique in the particular spreadsheet. Those in Example 3 are unique in the entire collection of spreadsheets.

```
C25  =C20*C30+D20*C35+E20*C40
C28  =SUM(C59:C108)
D28  =SUM(D59:D108)
```

Example 1. Some picked out formulas

row name	col name	element	row#	col#
C25	C30	dC20	1	8
C25	C35	dD20	1	15
C25	C40	dE20	1	22

Example 2. Preliminary preparation of the formula in cell 25 for optimizer

row name	col name	element	row#	col#
rLK_C25	cLK_C30	0	2701	4508
rLK_C25	cLK_C35	0	2701	4515
rLK_C25	cLK_C40	1	2701	4522

Example 3. Final preparation of the formula in cell 25 for optimizer

APPENDIX F

DATA CALL LETTER

DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY MATERIEL COMMAND
5001 EISENHOWER AVENUE, ALEXANDRIA, VA 22333 - 0001

REPLY TO ATTENTION OF

AMCEN-A

S: 1 APR 94
25 FEB 1994

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Data Call for the Pollution Abatement and Prevention Analysis (PAPA) Study

1. Reference memorandum, AMCEN-A, 17 Nov 93, subject: Pollution Abatement and Prevention Analysis (PAPA) Study.

2. We alerted you, with the reference memorandum, that the subject study was underway, and your assistance would be requested to complete it. The U.S. Army Concepts Analysis Agency (CAA), which is performing the study, has now requested assistance (please see enclosure 1, paragraphs 3 and 4), and has, in fact, already initially talked to the base study installations.

3. I request that you task the three base study installations (Corpus Christi Army Depot, Watervliet Arsenal, and Lone Star Army Ammunition Plant) to provide the CAA team the information they request. Specifically, I feel the following information should be sufficient for the purposes of this study:

a. The hazardous waste stream data they request should be limited to information on the largest waste streams (a minimum of three waste streams for each installation, and more if you have good information readily available), as taken from their most recent hazardous waste generation reports available. Please provide as much information as you have immediately available for each waste stream, such as flow rates per day and per year, minimum and maximum flow rates, chemicals present, wastewater makeup, source and destination of water, and other pertinent information.

b. Installations should limit the pollution prevention opportunities (PPOs) CAA has requested to six such PPOs on each installation that have already been completed, and for which good data is readily available. If they have additional PPOs that can be provided with minimum additional effort, these would be highly appreciated by the CAA.

c. The toxic chemical identifications requested by CAA is just the listing of chemicals associated with each waste stream, or PPO, and is not intended as another list of chemicals on the installation.

d. CAA has provided a data sheet which needs to be completed for each analysis

AMCEN-A
SUBJECT: Data Call for the Pollution Abatement and Prevention Analysis (PAPA) Study

(please see enclosure 2). It also includes instructions, but is mostly self explanatory. You should note that the data sheet asks for energy savings information. Tracking energy savings may not have been a high priority for any PPO, and therefore if you do not have that data, please mark this space as "Not Studied".

e. In all cases, installations should provide only that information which is readily available, or for which they can make good engineering estimates. I do not want them to conduct new studies or make significant new efforts to gather data which they do not now have. If the only numbers available are estimates, use those, and insert "(est.)" behind it. If a number is just not known, please mark as "unknown".

4. Enclosure 3 is the original tasking to CAA from the Deputy Assistant Secretary of the Army to perform this study.

5. CAA team members will visit each study installation, probably in March, to become better acquainted with their missions At the time of the visit, the installations should have identified which waste streams and which PPOs they will report on so that the CAA can concentrate on these, although finished reports are not due until 1 April 1994. Please send the requested information directly to: U.S. Army Concepts Analysis Agency, ATTN: CSCA-RSR, 8120 Woodmont Ave., Bethesda, MD 20814. CAA POCs are listed in enclosure 1.

6. POCs at AMCEN-A are Gary Berkner, DSN 284-8910, and Major Jeff Dell'Omo, DSN 284-8038.

7. AMC - America's Arsenal for the Brave.

FOR THE COMMANDER:

3 Encl

MARK W. POTTER
Colonel, GS
Deputy Chief of Staff for
Engineering, Housing, Environment,
and Installation Logistics

DEPARTMENT OF THE ARMY
US ARMY CONCEPTS ANALYSIS AGENCY
8120 WOODMONT AVENUE
BETHESDA, MARYLAND 20814-2797

REPLY TO
ATTENTION OF
CSCA-RSR

23 FEB 1994

MEMORANDUM FOR COMMANDER, U.S. ARMY MATERIEL COMMAND, ATTN: AMCEN (COL POTTER), 5001 EISENHOWER AVENUE, ALEXANDRIA, VA 22333-0001

SUBJECT: Data Call for the Pollution Abatement and Prevention Analysis (PAPA) Study

1. Reference memorandum, DASA-ESOH, 30 Dec 93, subject: Pollution Abatement and Prevention Analysis (PAPA) Study Directive (Encl 1).

2. The U.S. Army Concepts Analysis Agency (CAA) has been directed by the Office of the Assistant Secretary of the Army for Installations Logistics and Environment (OASA (I,L&E)) to develop and demonstrate an analytical methodology for evaluating the costs and benefits of investing in pollution abatement and prevention opportunities at Army facilities. The PAPA Study is responding to the Army's requirement for a quick turnaround decision support capability that can develop and evaluate investment strategies to prevent or reduce pollution, reduce operating and compliance costs, and comply with Army environmental policy.

3. We need your assistance in collecting data for this study. Specifically, request you task our three base case sites - Watervliet Arsenal, Lone Star Army Ammunition Plant, and Corpus Christi Army Depot - to provide us with hazardous waste stream data, toxic chemical identification, pollution prevention opportunities and cost/benefit data as it pertains to their operations. Source of information should be existing data and/or engineering estimates rather than new data development. Also, members of our PAPA Study team would like to visit the sites during the month of March. Please inform your environmental coordinators that we will contact them soon to schedule for the most convenient time for a visit.

4. The Pollution Prevention Opportunity Data Sheets (Encl 2) should be completed by the site environmental specialists prior to the study team visits. A set of instructions for completing the form, and an example of a completed data sheet are included. The instructions are provided to ensure uniformity of response.

5. Your assistance and support is greatly appreciated. If you have any questions, the PAPA Study Director is LTC Mike Leibel, CSCA-RSR, (DSN) 295-1082 or commercial (301) 295-1082.

FOR THE DIRECTOR:

M E Simmons

2 Encl

MICHAEL E. SIMMONS
Colonel, TC
Chief of Staff

POLLUTION PREVENTION OPPORTUNITY DATA SHEET

A. PROCESS GENERATION WASTE STREAM (HAZMIN/PP):

B. TOXIC CHEMICAL(S):

C. VOLUME/RATE (KG/YEAR): DISPOSAL COST:

D. POLLUTION PREVENTION ALTERNATIVE/OPPORTUNITY:

1. TITLE:

2. METHOD (RECYCLE, SUBSTITUTE, ETC.):

3. DESCRIPTION:

4. ECONOMIC LIFE:

5. STATUS (PENDING/IMPLEMENTED, DATE):

E. COSTS:

1. INVESTMENT (INSTALLED) COST:

2. OPERATION AND MAINTENANCE COST (PER YEAR):

F. BENEFITS:

1. PROJECTED WASTE REDUCTION (% PER YEAR):

2. COST SAVINGS (PER YEAR):

3. ENERGY SAVINGS (PER YEAR):

INSTALLATION:

POINT OF CONTACT: DATE:

POLLUTION PREVENTION OPPORTUNITY DATA

INSTRUCTION SHEET

A. PROCESS GENERATION WASTE STREAM (HAZMIN/PP): This is the specific unit operation/process that is the source of the HW, e.g. electroplating rinse, electroplating spent bath, paint blast media, etc., taken from the AMC Hazardous Waste Generations Report.

B. TOXIC CHEMICAL(S): The toxic chemical(s) found in the waste stream, either used as an input raw material or resulting from the process, that causes the waste to be classified as hazardous.

C. VOLUME/RATE (KG PER YEAR): The annual volume of hazardous waste generated as a result of a given process, expressed in kilograms (KG) per year. Include volumes of hazardous waste generated by semi/annual "process" tank solution changes, but not hazardous wastes resulting from a restoration project. DISPOSAL COST: The annual cost of disposing of the hazardous waste generated by the identified waste stream. Can be expressed in total dollars per year or dollars per KG per year.

D. POLLUTION PREVENTION ALTERNATIVE/OPPORTUNITY:

1. TITLE: Process name or title of the alternative or opportunity which is readily/commonly recognized within the industry. Vendor name may be used when technology, process, or product is unique and/or patented.

2. METHOD (RECYCLE, SUBSTITUTE, ETC.): The approach taken by this alternative/opportunity to reduce or eliminate the use of hazardous materials within the process generation waste stream. Typically includes; elimination (material or process), substitution (material or process), change (material or process), housekeeping, training, recycling, re-using, treatment, etc.

3. DESCRIPTION: Briefly describe the method or process used by the alternative/opportunity which produces the desired results. Avoid using a detailed technical description (i.e. formulas) which can only be understood by engineers. Should be detailed enough to grasp the approach presented.

4. ECONOMIC LIFE: The period of time the system or hardware effectively performs its intended function, through requirement for total system replacement. May include sub-component replacement.

5. STATUS (PENDING/IMPLEMENTED, DATE): State whether alternative/opportunity is proposed, pending, or has been implemented. If pending,

provide year when it is expected to be implemented. If implemented provide year when alternative/opportunity was installed or became effective.

E. COSTS:

1. INVESTMENT (INSTALLED) COST: Identify all procurement, facility modification and labor costs involved (if required) to acquire and install the system or process. Include all one time costs required to place the alternative/opportunity into operation (training, start-up, etc.).

2. OPERATION AND MAINTENANCE COST (PER YEAR): All costs associated with routine operation and maintenance of the system or opportunity. Include labor and expendable/consumable materials. Costs figured on an annual basis. Can be presented in actual dollars or percent (fraction) of acquisition cost.

F. BENEFITS:

1. PROJECTED WASTE REDUCTION (% PER YEAR): Percent of hazardous waste reduced from C (above), proposed or achieved, as a result of implementing the alternative/opportunity. Rate can be an actual amount or an engineering estimate on an annual basis.

2. COST SAVINGS (PER YEAR): Net difference between annual operational costs of no change (status quo) and annual operational costs of pollution prevention alternative/opportunity. Do not include one time investment and installation costs. For this computation, include hazardous waste disposal costs for old and new alternative/opportunity. Must reflect savings on an annual basis.

3. ENERGY SAVINGS (PER YEAR): Net difference of energy requirements/consumption between no change (status quo) and pollution prevention alternative/opportunity on an annual basis. Can be reflected in millions of British thermal units (MBtu), kilowatts per year (kW/yr), barrels of oil equivalents (boe), or cubic feet (cf) of gas. Use the unit of measure reflected in your local energy management and reduction program.

The INSTALLATION, POINT OF CONTACT and DATE information is self explanatory. Include telephone number.

POLLUTION PREVENTION OPPORTUNITY DATA SHEET

A. PROCESS GENERATION WASTE STREAM (HAZMIN/PP): Plating, chromic acid

B. TOXIC CHEMICAL(S): Chromium

C. VOLUME/RATE (KG/YEAR): 82,078 kg DISPOSAL COST: $1,200/kt

D. POLLUTION PREVENTION ALTERNATIVE/OPPORTUNITY:

1. TITLE: Chromium Oxidation and Recovery System

2. METHOD (RECYCLE, SUBSTITUTE, ETC.): Recycle/reclaim

3. DESCRIPTION: Equipment reclaims chromium from rinse tanks and plating baths. System removes impurities and oxidizes trivalent chromium to hexavalant chromium.

4. ECONOMIC LIFE: 17 years

5. STATUS (PENDING/IMPLEMENTED, DATE): Implemented in 1991

E. COSTS:

1. INVESTMENT (INSTALLED) COST: $80,000.00

2. OPERATION AND MAINTENANCE COST (PER YEAR): $8,000.00/yr

F. BENEFITS:

1. PROJECTED WASTE REDUCTION (%PER YEAR): 60% reduction in chromium waste/yr

2. COST SAVINGS (PER YEAR): $35,694.00 (est)

3. ENERGY SAVINGS (PER YEAR): $1,200.00/yr

INSTALLATION: Concepts Analysis Agency

POINT OF CONTACT: Mr. Duane Gory, 295-1082 DATE: 7 Feb 94

APPENDIX G

EXECUTIVE ORDER 12856

THE EXECUTIVE ORDER

41981

Federal Register
Vol. 58, No. 150
Friday, August 6, 1993

Presidential Documents

Title 3—
The President

Executive Order 12856 of August 3, 1993

Federal Compliance With Right-to-Know Laws and Pollution Prevention Requirements

WHEREAS, the Emergency Planning and Community Right-to-Know Act of 1986 (42 U.S.C. 11001–11050) (EPCRA) established programs to provide the public with important information on the hazardous and toxic chemicals in their communities, and established emergency planning and notification requirements to protect the public in the event of a release of extremely hazardous substances;

WHEREAS, the Federal Government should be a good neighbor to local communities by becoming a leader in providing information to the public concerning toxic and hazardous chemicals and extremely hazardous substances at Federal facilities, and in planning for and preventing harm to the public through the planned or unplanned releases of chemicals;

WHEREAS, the Pollution Prevention Act of 1990 (42 U.S.C. 13101-13109) (PPA) established that it is the national policy of the United States that whenever feasible, pollution should be prevented or reduced at the source, that pollution that cannot be prevented should be recycled in an environmentally safe manner; that pollution that cannot be prevented or recycled should be treated in an environmentally safe manner; and that disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner;

WHEREAS, the PPA required the Administrator of the Environmental Protection Agency (EPA) to promote source reduction practices in other agencies;

WHEREAS, the Federal Government should become a leader in the field of pollution prevention through the management of its facilities, its acquisition practices, and in supporting the development of innovative pollution prevention programs and technologies;

WHEREAS, the environmental, energy, and economic benefits of energy and water use reductions are very significant; the scope of innovative pollution prevention programs must be broad to adequately address the highest-risk environmental problems and to take full advantage of technological opportunities in sectors other than industrial manufacturing; the Energy Policy Act of 1992 (Public Law 102–486 of October 24, 1992) requires the Secretary of Energy to work with other Federal agencies to significantly reduce the use of energy and reduce the related environmental impacts by promoting use of energy efficiency and renewable energy technologies; and

WHEREAS, as the largest single consumer in the Nation, the Federal Government has the opportunity to realize significant economic as well as environmental benefits of pollution prevention;

AND IN ORDER TO:

Ensure that all Federal agencies conduct their facility management and acquisition activities so that, to the maximum extent practicable, the quantity of toxic chemicals entering any wastestream, including any releases to the environment, is reduced as expeditiously as possible through source reduction; that waste that is generated is recycled to the maximum extent practicable; and that any wastes remaining are stored, treated or disposed of in a manner protective of public health and the environment;

Require Federal agencies to report in a public manner toxic chemicals entering any wastestream from their facilities, including any releases to the environment, and to improve local emergency planning, response, and accident notification; and

Help encourage markets for clean technologies and safe alternatives to extremely hazardous substances or toxic chemicals through revisions to specifications and standards, the acquisition and procurement process, and the testing of innovative pollution prevention technologies at Federal facilities or in acquisitions;

NOW THEREFORE, by the authority vested in me as President by the Constitution and the laws of the United States of America, including the EPCRA, the PPA, and section 301 of title 5, United States Code, it is hereby ordered as follows:

Section 1. *Applicability.*

1-101. As delineated below, the head of each Federal agency is responsible for ensuring that all necessary actions are taken for the prevention of pollution with respect to that agency's activities and facilities, and for ensuring that agency's compliance with pollution prevention and emergency planning and community right-to-know provisions established pursuant to all implementing regulations issued pursuant to EPCRA and PPA.

1 102. Except as otherwise noted, this order is applicable to all Federal agencies that either own or operate a "facility" as that term is defined in section 329(4) of EPCRA, if such facility meets the threshold requirements set forth in EPCRA for compliance as modified by section 3-304(b) of this order ("covered facilities"). Except as provided in section 1-103 and section 1-104 below, each Federal agency must apply all of the provisions of this order to each of its covered facilities, including those facilities which are subject, independent of this order, to the provisions of EPCRA and PPA (*e.g.*, certain Government-owned/contractor-operated facilities (GOCO's), for chemicals meeting EPCRA thresholds). This order does not apply to Federal agency facilities outside the customs territory of the United States, such as United States diplomatic and consular missions abroad.

1-103. Nothing in this order alters the obligations which GOCO's and Government corporation facilities have under EPCRA and PPA independent of this order or subjects such facilities to EPCRA or PPA if they are otherwise excluded. However, consistent with section 1-104 below, each Federal agency shall include the releases and transfers from all such facilities when meeting all of the Federal agency's responsibilities under this order.

1-104. To facilitate compliance with this order, each Federal agency shall provide, in all future contracts between the agency and its relevant contractors, for the contractor to supply to the Federal agency all information the Federal agency deems necessary for it to comply with this order. In addition, to the extent that compliance with this order is made more difficult due to lack of information from existing contractors, Federal agencies shall take practical steps to obtain the information needed to comply with this order from such contractors.

Sec. 2-2. *Definitions.*

2-201. All definitions found in EPCRA and PPA and implementing regulations are incorporated in this order by reference, with the following exception: for the purposes of this order, the term "person", as defined in section 329(7) of EPCRA, also includes Federal agencies.

2-202. *Federal agency* means an Executive agency, as defined in 5 U.S.C. 105. For the purpose of this order, military departments, as defined in 5 U.S.C 102, are covered under the auspices of the Department of Defense.

2-203. *Pollution Prevention* means "source reduction," as defined in the PPA, and other practices that reduce or eliminate the creation of pollutants through: (a) increased efficiency in the use of raw materials, energy, water, or other resources; or (b) protection of natural resources by conservation.

2-204. *GOCO* means a Government-owned/contractor-operated facility which is owned by the Federal Government but all or portions of which are operated by private contractors.

2-205. *Administrator* means the Administrator of the EPA.

2-206. *Toxic Chemical* means a substance on the list described in section 313(c) of EPCRA.

2-207. *Toxic Pollutants.* For the purposes of section 3-302(a) of this order, the term "toxic pollutants" shall include, but is not necessarily limited to, those chemicals at a Federal facility subject to the provisions of section 313 of EPCRA as of December 1, 1993. Federal agencies also may choose to include releases and transfers of other chemicals, such as "extremely hazardous chemicals" as defined in section 329(3) of EPCRA, hazardous wastes as defined under the Resource Conservation and Recovery Act of 1976 (42 U.S.C 6901–6986) (RCRA), or hazardous air pollutants under the Clean Air Act Amendments (42 U.S.C. 7403-7626); however, for the purposes of establishing the agency's baseline under 3-302(c), such "other chemicals" are in addition to (not instead of) the section 313 chemicals. The term "toxic pollutants" does not include hazardous waste subject to remedial action generated prior to the date of this order.

Sec. 3-3. *Implementation.*

3-301. *Federal Agency Strategy.* Within 12 months of the date of this order, the head of each Federal agency must develop a written pollution prevention strategy to achieve the requirements specified in sections 3-302 through 3–305 of this order for that agency. A copy thereof shall be provided to the Administrator. Federal agencies are encouraged to involve the public in developing the required strategies under this order and in monitoring their subsequent progress in meeting the requirements of this order. The strategy shall include, but shall not be limited to, the following elements:

(a) A pollution prevention policy statement, developed by each Federal agency, designating principal responsibilities for development, implementation, and evaluation of the strategy. The statement shall reflect the Federal agency's commitment to incorporate pollution prevention through source reduction in facility management and acquisition, and it shall identify an individual responsible for coordinating the Federal agency's efforts in this area.

(b) A commitment to utilize pollution prevention through source reduction, where practicable, as the primary means of achieving and maintaining compliance with all applicable Federal, State, and local environmental requirements.

3-302. Toxic Chemical Reduction Goals. (a) The head of each Federal agency subject to this order shall ensure that the agency develops voluntary goals to reduce the agency's total releases of toxic chemicals to the environment and off-site transfers of such toxic chemicals for treatment and disposal from facilities covered by this order by 50 percent by December 31, 1999. To the maximum extent practicable, such reductions shall be achieved by implementation of source reduction practices.

(b) The baseline for measuring reductions for purposes of achieving the 50 percent reduction goal for each Federal agency shall be the first year in which releases of toxic chemicals to the environment and off-site transfers of such chemicals for treatment and disposal are publicly reported. The baseline amount as to which the 50 percent reduction goal applies shall be the aggregate amount of toxic chemicals reported in the baseline year for all of that Federal agency's facilities meeting the threshold applicability requirements set forth in section 1-102 of this order. In no event shall the baseline be later than the 1994 reporting year.

(c) Alternatively, a Federal agency may choose to achieve a 50 percent reduction goal for toxic pollutants. In such event, the Federal agency shall delineate the scope of its reduction program in the written pollution prevention strategy

that is required by section 3-301 of this order. The baseline for measuring reductions for purposes of achieving the 50 percent reduction requirement for each Federal agency shall be the first year in which releases of toxic pollutants to the environment and off-site transfers of such chemicals for treatment and disposal are publicly reported for each of that Federal agency's facilities encompassed by section 3-301. In no event shall the baseline year be later than the 1994 reporting year. The baseline amount as to which the 50 percent reduction goal applies shall be the aggregate amount of toxic pollutants reported by the agency in the baseline year. For any toxic pollutants included by the agency in determining its baseline under this section, in addition to toxic chemicals under EPCRA, the agency shall report on such toxic pollutants annually under the provisions of section 3-304 of this order, if practicable, or through an agency report that is made available to the public.

(d) The head of each Federal agency shall ensure that each of its covered facilities develops a written pollution prevention plan no later than the end of 1995, which sets forth the facility's contribution to the goal established in section 3-302(a) of this order. Federal agencies shall conduct assessments of their facilities as necessary to ensure development of such plans and of the facilities' pollution prevention programs.

3-303. *Acquisition and Procurement Goals.* (a) Each Federal agency shall establish a plan and goals for eliminating or reducing the unnecessary acquisition by that agency of products containing extremely hazardous substances or toxic chemicals. Similarly, each Federal agency shall establish a plan and goal for voluntarily reducing its' own manufacturing, processing, and use of extremely hazardous substances and toxic chemicals. Priorities shall be developed by Federal agencies, in coordination with EPA, for implementing this section.

(b) Within 24 months of the date of this order, the Department of Defense (DOD) and the General Services Administration (GSA), and other agencies, as appropriate, shall review their agency's standardized documents, including specifications and standards, and identify opportunities to eliminate or reduce the use by their agency of extremely hazardous substances and toxic chemicals, consistent with the safety and reliability requirements of their agency mission. The EPA shall assist agencies in meeting the requirements of this section, including identifying substitutes and setting priorities for these reviews. By 1999, DOD, GSA and other affected agencies shall make all appropriate revisions to these specifications and standards.

(c) Any revisions to the Federal Acquisition Regulation (FAR) necessary to implement this order shall be made within 24 months of the date of this order.

(d) Federal agencies are encouraged to develop and test innovative pollution prevention technologies at their facilities in order to encourage the development of strong markets for such technologies. Partnerships should be encouraged between industry, Federal agencies, Government laboratories, academia, and others to assess and deploy innovative environmental technologies for domestic use and for markets abroad.

3-304. *Toxics Release Inventory/Pollution Prevention Act Reporting.* (a) The head of each Federal agency shall comply with the provisions set forth in section 313 of EPCRA, section 6607 of PPA, all implementing regulations, and future amendments to these authorities, in light of applicable guidance as provided by EPA.

(b) The head of each Federal agency shall comply with these provisions without regard to the Standard Industrial Classification (SIC) delineations that apply to the Federal agency's facilities, and such reports shall be for all releases, transfers, and wastes at such Federal agency's facility without regard to the SIC code of the activity leading to the release, transfer, or waste. All other existing statutory or regulatory limitations or exemptions on the application of EPCRA section 313 shall apply to the reporting requirements set forth in section 3-304(a) of this order.

(c) The first year of compliance shall be no later than for the 1994 calendar year with reports due on or before July 1, 1995

3-305. *Emergency Planning and Community Right-to-Know Reporting Responsibilities.* The head of each Federal agency shall comply with the provisions set forth in sections 301 through 312 of EPCRA, all implementing regulations, and future amendments to these authorities in light of any applicable guidance as provided by EPA. Effective dates for compliance shall be: (a) With respect to the provisions of section 302 of EPCRA emergency planning notification shall be made no later than 7 months after the date of this order.

(b) With respect to the provisions of section 303 of EPCRA all information necessary for the applicable Local Emergency Planning Committee (LEPC's) to prepare or revise local Emergency Response Plans shall be provided no later than 1 year after the date of this order.

(c) To the extent that a facility is required to maintain Material Safety Data Sheets under any provisions of law or Executive order, information required under section 311 of EPCRA shall be submitted no later than 1 year after the date of this order, and the first year of compliance with section 312 shall be no later than the 1994 calendar year, with reports due on or before March 1, 1995.

(d) The provisions of section 304 of EPCRA shall be effective beginning January 1, 1994.

(e) These compliance dates are not intended to delay implementation of earlier timetables already agreed to by Federal agencies and are inapplicable to the extent they interfere with those timetables.

Sec. 4–4. *Agency Coordination.*

4–401. By February 1, 1994, the Administrator shall convene an interagency Task Force composed of the Administrator, the Secretaries of Commerce, Defense, and Energy, the Administrator of General Services, the Administrator of the Office of Procurement Policy in the Office of Management and Budget, and such other agency officials as deemed appropriate based upon lists of potential participants submitted to the Administrator pursuant to this section by the agency head. Each agency head may designate other senior agency officials to act in his/her stead, where appropriate. The Task Force will assist the agency heads in the implementation of the activities required under this order.

4–402. Federal agencies subject to the requirements of this order shall submit annual progress reports to the Administrator beginning on October 1, 1995. These reports all include a description of the progress that the agency has made in complying with all aspects of this order, including the pollution reductions requirements. This reporting requirement shall expire after the report due on October 1, 2001.

4–403. *Technical Advice.* Upon request and to the extent practicable, the Administrator shall provide technical advice and assistance to Federal agencies in order to foster full compliance with this order. In addition, to the extent practicable, all Federal agencies subject to this order shall provide technical assistance, if requested, to LEPC's in their development of emergency response plans and in fulfillment of their community right-to-know and risk reduction responsibilities.

4–404. Federal agencies shall place high priority on obtaining funding and resources needed for implementing all aspects of this order, including the pollution prevention strategies, plans, and assessments required by this order, by identifying, requesting, and allocating funds through line-item or direct funding requests. Federal agencies shall make such requests as required in the Federal Agency Pollution Prevention and Abatement Planning Process and through agency budget requests as outlined in Office of Management and Budget (OMB) Circulars A-106 and A-11, respectively. Federal agencies should apply to the maximum extent practicable, a life cycle analysis and total cost accounting principles to all projects needed to meet the requirements of this order.

4–405. *Federal Government Environmentall Challenge Program.* The Administrator shall establish a "Federal Government Environmental Challenge Program" to recognize outstanding environmental management performance in Federal agencies and facilities. The program shall consist of two components that challenge Federal agencies; (a) to agree to a code of environmental principles to be developed by EPA, in cooperation with other agencies, that emphasizes pollution prevention, sustainable development and state of-the-art environmental management programs, and (b) to submit applications to EPA for individual Federal agency facilities for recognition as "Model Installations." The program shall also include a means for recognizing individual Federal employees who demonstrate outstanding leadership in pollution prevention.

Sec 5–5. *Compliance.*

5-501. By December 31,1993, the head of each Federal agency shall provide the Administrator with a preliminary list of facilities that potentially meet the requirements for reporting under the threshold provisions of EPCRA, PPA, and this order.

5-502. The head of each Federal agency is responsible for ensuring that such agency take all necessary actions to prevent pollution in accordance with this order, and for that agency's compliance with the provisions of EPCRA and PPA. Compliance with EPCRA and PPA means compliance with the same substantive, procedural, and other statutory and regulatory requirements that would apply to a private person. Nothing in this order shall be construed as making the provisions of sections 325 and 326 of EPCRA applicable to any Federal agency or facility, except to the extent that such Federal agency or facility would independently be subject to such provisions. EPA shall consult with Federal agencies, if requested, to determine the applicability of this order to particular agency facilities.

5-503. Each Federal agency subject to this order shall conduct internal reviews and audits, and take such other steps, as may be necessary to monitor compliance with sections 3-304 and 3-305 of this order.

5-504. The Administrator, in consultation with the heads of Federal agencies, may conduct such reviews and inspections as may be necessary to monitor compliance with sections 3-304 and 3-305 of this order. Except as excluded under section 6–601 of this order, all Federal agencies are encouraged to cooperate fully with the efforts of the Administrator to ensure compliance with sections 3-304 and 3-305 of this order.

5-505. Federal agencies are further encouraged to comply with all state and local right-to-know and pollution prevention requirements to the extent that compliance with such laws and requirements is not otherwise already mandated.

5-506. Whenever the Administrator notifies a Federal agency that it is not in compliance with an applicable provision of this order, the Federal agency shall achieve compliance as promptly as is practicable.

5-507. The EPA shall report annually to tho President on Federal agency compliance with the provisions of section 3-304 of this order.

5-508. To the extent permitted by law and unless such documentation is withheld pursuant to section 6–601 of this order, the public shall be afforded ready access to all strategies, plans, and reports required to be prepared by Federal agencies under this order by the agency preparing the strategy, plan, or report. When the reports are submitted to EPA, EPA shall compile the strategies, plans, and reports and make them publicly available as well. Federal agencies are encouraged to provide such strategies, plans, and reports to the State and local authorities where their facilities are located for an additional point of access to the public.

Sec. 6-6. *Exemption.*

6-601. In the interest of national security, the head of a Federal agency may request from the President an exemption from complying with the provisions of any or all aspects of this order for particular Federal agency facilities, provided that the procedures set forth in section 120(j)(1) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (42 U.S.C. 9620(j)(1)), are followed. To the maximum extent practicable, and without compromising national security, all Federal agencies shall strive to comply with the purposes, goals, and implementation steps set forth in this order.

Sec. 7-7. *General Provisions.*

7-701. Nothing in this order shall create any right or benefit, substantive or procedural, enforceable by a party against the United States, its agencies or instrumentalities, its officers or employees, or any other person.

William J. Clinton

THE WHITE HOUSE,

August 3, 1993.

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APPENDIX H

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GLOSSARY

1. ABBREVIATIONS, ACRONYMS, AND SHORT TERMS

ACSIM	Assistant Chief of Staff for Installation Management
ACTS	Army Compliance Tracking System
AEC	Army Environmental Center
ANAD	Anniston Army Depot
AMC	US Army Materiel Command
AR	Army Regulation
ASAIL&E	Assistant Secretary of the Army for Installations, Logistics, and Environment
Btu	British thermal unit
CAA	US Army Concepts Analysis Agency
CCAD	Corpus Christi Army Depot
CONUS	continental United States
CY	calendar year
DA	Department of the Army
DERA	Defense Environmental Restoration Account
DERP	Defense Environmental Restoration Program
DOD	Department of Defense
ECO	energy conservation opportunity
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FY	fiscal year
gal	gallon(s)
HAZMIN/PP	hazardous waste minimization/pollution prevention
HQDA	Headquarters, Department of the Army
IOC (CTX)	Industrial Operations Command (Center for Technical Excellence)

kg	kilogram
kWh	kilowatt hour
LEAD	Letterkenny Army Depot
LSAAP	Lone Star Army Ammunition Plant
MACOM	major Army command
ODEP	Office of the Director of Environmental Programs
O&M	operations and maintenance
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
P2	pollution prevention
PAPA	Pollution Abatement and Prevention Analysis Study
PIM	PAPA Investment Model
POM	Program Objective Memorandum
PPO	pollution prevention opportunity
REEP	Renewables and Energy Efficiency Planning Study
RRAD	Red River Army Depot
STON	short ton
TERPS	The Environmental Resources Programming Study
TEAD	Tooele Army Depot
TOAD	Tobyhanna Army Depot
TRI	Toxic Release Inventory (report)
WVA	Watervliet Arsenal

2. DEFINITIONS

Class II-O
Funding group of projects with EPA classification Code II, rated as either "medium" or "low" by the field commander generating the project submission into the RCS 1383 data base.

Environmental Compliance Achievement Program (ECAP)
An umbrella program that integrates the five basic steps required to achieve and maintain environmental compliance: training; planning and programming; resources; assessing; and correcting deficiencies. It includes projects and activities related to hazardous waste disposal and minimization, repairs and improvements to meet emission and discharge standards, underground storage tank inspection and repair, groundwater monitoring, environmental documentation, environmental compliance assessments, training in pollution abatement for all media, and other related efforts to achieve and maintain compliance with environmental regulations.

Environmental Compliance Assessment System (ECAS)
A formal system using environmental compliance audits to identify deficiencies and incorporate environmental projects designed to address those noted deficiencies within the RCS 1383 Report. Primary goals are to ensure that Army facilities are in compliance with applicable federal, state, and local environmental requirements; identify the Army's environmental resource requirements for compliance; provide a profile mechanism for measuring progress toward compliance; help integrate management of all environmental programs at each echelon. Includes design of correct action plans and implementing "fixes" for identified deficiencies.

emergency planning requirements (under 40 CFR, part 355)
These requirements apply to any facility at which there is present an amount of any extremely hazardous substance equal to or in excess of its threshold planning quantity (TPQ), or designated, after public notice and opportunity for comment, by the commission or the governor for the state in which the facility is located. An amount of any extremely hazardous substance means the total amount of an extremely hazardous substance present at any one time at a facility at concentrations greater than 1 percent by weight, regardless of location, number of containers, or method of storage.

emergency release notification requirements (under 40 CFR, Part 355)
The requirements of this section apply to any facility (i) at which a hazardous chemical is produced, used or stored *and* (ii) at which there is release of a reportable quantity (RQ) of any extremely hazardous substance or CERCLA hazardous substance.

facility
All buildings, equipment, structures, and other stationary items which are located on a single site or on contiguous or adjacent sites and which are owned or operated by the same person (or by any person which controls, is controlled by, or under common control with, such person). For purposes of emergency release notification, the term includes motor vehicles, rolling stock, and aircraft.

hazardous chemical
Any substance on the list described in section 313(c) of the Superfund Amendments and Reauthorization Act (SARA) of 1986. This list contains approximately 366 chemicals, selected by Congress, which impose a health hazard due to their chronic or long-term toxicity.

mass balancing
A term describing the process used to account for pollution release to the environment which cannot be, or is not, directly measured.

must fund
Funding policy established by HQDA for environmental projects. Includes projects identified as Class I (to correct out of compliance condition), Class II-High, (essential to find immediately in order to preclude near-term noncompliance condition), and Class III-High (program management). Also includes planned costs for hazardous waste material disposal.

source reduction
Any practice which reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream of otherwise released into the environment prior to recycling, treatment, or disposal. It includes equipment or technology modifications, process or procedure modifications, reformulation of redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

release
Any spilling, leaking, pumping, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles) of any hazardous substance, or CERCLA hazardous substance.

reportable quantity (RQ)
For any CERCLA hazardous substance, the reportable quantity established in Table 302.4 of 40 CFR, Part 302, for such substance. For any other substance, the reportable quantity is one pound.

threshold planning quantity (TPQ)
A stipulated storage level of (quantity in pounds) for a substance that reflects a health and/or safety concern (risk) if the entire quantity of that substance were released. Based on the toxicity and mobility of the chemical.

pollution abatement
The use of materials, processes, or practices that reduce the degree or intensity of pollution or eliminate pollution completely.

pollution prevention
The use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes practices that reduce the use of hazardous materials, energy, water, or other resources, and practices that protect natural resources through conservation or more efficient use.